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NATURAL HISTORY

THE JOURNAL OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XXXVIII

June-December, 1936

TEN ISSUES A YEAR

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

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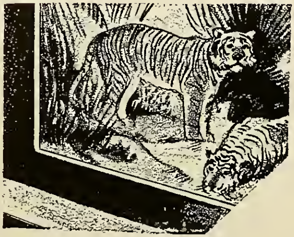

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The Magazine of the American Museum of Natural History

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Publication Office: American Museum of Natural History, Seventy-seventh Street and Central Park West, New York, N. Y.

Editorial: Edward M. Weyer, Jr., Ph.D., Editor; Thomas Gordon Lawrence, M. A.; Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

Subscriptions. Natural History is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

Advertising: Sherman P. Voorhees, The American Museum of Natural History.

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The Archer Fish in Action

Fantastic creatures usually lose their incredible attributes in the light of science. Here is one, long doubted by scientists, that becomes more remarkable the more we learn of it. In the accompanying article Doctor Smith narrates his personal experiences with the "blow-pipe" fish, and explains for the first time the apparatus which enables this strange fish to "shoot" its food

The Archer Fish

It secures its food by shooting insects with a pellet of water, and almost never misses its target at four feet

By HUGH M. SMITH
Formerly Fisheries Advisor to the Kingdom of Siam.

WHEN I went to Siam to study the remarkable fish life of the fresh and salt waters, one of the things I was most anxious to do was to make the intimate acquaintance of the archer fish, a creature which gets its living by a unique practice which had never been satisfactorily explained by scientists.

In the eighteenth century and earlier, vague accounts reached Europe regarding an oriental fish which obtained its food, consisting of insects, by knocking them down with drops of water propelled from its mouth. These accounts, unsupported by reliable evidence, doubtless met with a mixed reception on the part of zoölogists and the general public; and it may be imagined that the scientific world of that day was eager to obtain authentic information concerning a creature whose behavior was so different from that of any other known fish.

The earliest record

The first definite printed reference to the fish in a European language seems to have been published in the year 1765, in the *Philosophical Transactions of the Royal Society of London*. At a meeting of the society held on March 15, 1764, a communication* was read from John Albert Schlosser, M.D., F.R.S., of Amsterdam, announcing the presentation to the society of a specimen of the fish which, to quote him, "I believe hath never been observed by any writer on natural history." The communication carried a description of the peculiar habits of the fish on the authority of a Mr. Hommel, governor of a hospital in Batavia, who was also the collector of the specimen. Designated as "the jaculator or shooting fish, a name alluding to its nature," the creature was described as follows:

> It frequents the shores and sides of the sea and rivers, in search of food. When it spies a fly sitting on the plants, that grow in shallow water, it swims on to the distance of four, five or six feet, and then, with surprising dexterity, it ejects out of its tubular mouth a single drop of water, which never fails striking the fly into the sea, where it soon becomes its prey. The relation of this uncommon action of this cunning fish raised the governor's curiosity; though it came well attested, yet he was determined, if possible, to be convinced of the truth, by ocular demonstration. For that purpose, he ordered a large, wide tun to be filled with sea-water; then had some of these caught, and put into it, which was changed every other day. In a while, they seemed reconciled to their confinement; then he determined to try the experiment. A slender stick, with a fly pinned on at its end, was placed in such a direction, on the side of the vessel, as the fish could strike it. It was with inexpressible delight, that he daily saw these fish exercising their skill in shooting at the fly with amazing dexterity, and never missed the mark.†

---

*"An Account of a Fish from Batavia, called Jaculator." *Philosophical Transactions*, Vol. LV, for the year 1764, p. 89-91, plate 9.

†Unfortunately for the accuracy of the record, the fish to which Hommel referred and the specimen which he sent to London were entirely different species. Appended to the article was a copy of a description given in 1754 by Linnaeus of a species called *Chaetodon rostratum* (known in later years as *Chelmo rostratus*), and the accompanying plate was of that fish of the coral reefs. There were thus precipitated the misunderstanding and doubt concerning this fish which lasted for nearly a century and a half.

IMPORTANT NOTICE TO MEMBERS

Natural History is not published during July and August. Therefore it will not be necessary for members to send in a change of address notice if they are to reside at a summer residence during these two months.

A second article on this fish,* also contributed by Doctor Schlosser, contained a description of the fish in Mr. Hommel's own words and gave additional information on the fish's peculiar habits.

Shooting powers denied

During practically the whole of the nineteenth century there seem to have been no new observations on the shooting powers attributed to the archer fish and no confirmation of the statements made by Hommel in 1765 and 1767. On the contrary, the leading authorities on oriental fishes denied that the fish did or could perform as claimed.

Dr. Pieter Bleeker, "the most active ichthyologist that ever lived," who spent more than thirty-five years studying the fishes of the orient, was author of more than four hundred articles on those fishes, and was long a resident of the same city (Batavia) as Hommel, was unable to verify the early accounts of the jaculator fish and in 1875 expressed the belief that it did not deserve the celebrity which had been imposed on it and that its reputation was based on an error of observation.

Dr. Francis Day, who devoted more than a quarter of a century to the investigation of the fishes of India and Burma and published monumental works thereon, withheld from Toxotes any credit whatever for its extraordinary shooting ability and erroneously ascribed to the coral-reef fish Chelmo the same ability. Thus, in "The Fauna of British India—Fishes" (1889), Day disposed of Toxotes in these words:

> It is stated in some works that these wide-mouthed fishes shoot insects with a drop of water in Batavia. Bleeker observed that he never witnessed this, and the action is one which the mouths of these fishes appear incapable of effecting.

In an earlier article,† "On Asiatic Blowpipe Fishes," Day argued that Hommel's account could not have applied to Toxotes and could only have referred to Chelmo. He claimed that "no one, that I can ascertain, has asserted that *Toxotes jaculator,* with its deeply cleft mouth, was able to use it as a blowpipe," and said further that "personally I paid special attention to this question when investigating the fishes of Burma, but no fisherman had ever heard of this ingenuity being attributed to Toxotes, and which I cannot help thinking, with the late Doctor Bleeker, must be an error."

The original source of misunderstanding, as disclosed by the articles in the *Philosophical Transactions* and the perpetuation of the error by Bleeker, Day, and others, was undoubtedly due in some measure to the fact that among the Malays both Toxotes and Chelmo are called by the same name, *sumpit-sumpit* (from *sumpitan,* a blowpipe).

One more quotation from a reputable source may be given to illustrate the attitude of mind toward the most characteristic habit attributed to the archer fish; this is from a notice of Toxotes by the late Professor J. S. Kingsley appearing in the *Standard Natural History* (Vol. 3, 1885):

> One of the species has been generally credited with the faculty of shooting drops of water at insects on low-hanging branches and thus securing them for food. There does not appear to be any adaptation in the organization of the mouth for such a feat, and skepticism must be exercised in the acceptance of the statement made. Certainly no recent confirmation of the old story has been given, and the tradition has probably resulted from some misunderstanding.

The fish comes into its own

Although several minor notices of the habits of Toxotes appeared in European periodicals in the last two or three years of the nineteenth century, it was not until the twentieth century had dawned that this fish may be said to have finally come into its own. The observations of a Russian ichthyologist, Zolotnisky, on the fish in captivity definitely corroborated the essential facts of behavior as set forth in the earliest published accounts.‡ A number of living specimens had been obtained in Singapore, and these were subjected to close scrutiny and experimentation, with the result that not only were the long-disputed habits fully established, but new items of behavior were noted and set forth.

---

*"Some further Intelligence relating to the Jaculator Fish." *Transactions of the Philosophical Society*, Vol. LVI, for the year 1766, p. 186-188, plate 8, fig. 6. Doctor Schlosser this time presented another specimen, and a description of it under the name *Sciaena jaculatrix* was given by the German zoōlogist Pallas. A poor but easily recognizable illustration accompanied the article. The allocation of the species with the sciaenid fishes, or drums, was unfortunate, as there is not even a remote relationship; and in 1817 Cuvier corrected the error and established the genus Toxotes for the reception of the fish which has since been known as *Toxotes jaculator*. This form and five closely related species constitute the family Toxotidae, peculiar to the oriental region.

†*Zoōlogist*, 1881, p. 91.

‡Zolotnisky's detailed report, "Le Poisson Archer (*Toxotes jaculator*) en Aquarium" was issued in 1902 in *Archives de Zoologie Experimentale et Generale*. Vol. X, p. lxxiv—lxxxiv.

Among the facts regarding Toxotes which were recorded by Zolotnisky and have been confirmed by the present writer and other persons in Asia and America were the following:

(1) The fish subsists largely on insects which hover over the water or rest on overhanging vegetation. When a fish approaches within a certain distance of an insect, it becomes stationary, points its head and turns its eyes directly at the prey, brings the front of its mouth to the surface of the water, partly opens the mouth, and forthwith propels a drop, or several drops, of water at the insect, which ordinarily is 12 to 20 inches distant, but may be 40 inches or more. The aim is true and the insect falls into the water and is at once devoured.

(2) The fish frequently swims backward. This habit is often observed when the fish reconnoiters a prospective prey, and backs from it in order to secure a good position for observation and attack.

(3) The eyes sparkle with seeming intelligence and their mobility is noteworthy. They can be directed laterally, upward, and backward, but may not be turned downward.

(4) Aerial vision is acute. Even small insects may be seen at a great distance and fall a prey to the fish's amazingly accurate aim.

(5) Discrimination and selection are apparently exercised in the choice of food; considerable ingenuity is sometimes employed in obtaining food; and in shooting at insects the distance and the force are gauged.

Doubt

Zolotnisky's paper was made the basis for a critical review of "The Archer Fish and Its Feats" by the erudite Dr. Theodore Gill, published by the Smithsonian Institution in 1909*; and the foregoing statement of Zolotnisky's observations is largely a paraphrase of Gill's rendering. Gill found it difficult to accept some of Zolotnisky's statements and in concluding his paper said:

> This summary is a true version of the article by Zolotnisky and will doubtless excite skepticism among physiologists at large as well as psychologists. It contravenes certain assumptions respecting the power and range of vision among fishes, as well as of the intelligence and reasoning powers of such lowly animals. The extent of expression assigned to eyes destitute of mobile surroundings and accommodative adjustments may also be deemed to be exaggerated. Distinction therefore must be exercised between the facts observed (or alleged to have been observed) and the inferences respecting such facts. It must be conceded, however, that fishes which manifest such peculiar action as the archers should be subjects for still more elaborate observations and experiments.

In recent years in America many people have become acquainted with the archer fish and its performances through examples in aquaria in New York, Philadelphia, and other cities; and a motion picture of a fish in action has been made at the New York Aquarium. The present generation of fish students everywhere may be pardoned for expressing surprise at the protracted skepticism, and wonder at the failure of doubting oriental ichthyologists to conduct practical tests.

How Toxotes shoots

One searches the literature in vain for an explanation or suggestion as to how an archer fish is able to propel a drop of water with such force and accuracy that it can dislodge insects on overhanging vegetation or hit them on the wing.

The doubt shown by zoölogists of the last century in regard to the reputed shooting powers of the fish was partly due to their failure to detect in the fish's mouth any special mechanism by which drops of water could be formed and expelled.

It is, of course, obvious that there must be some peculiar adaptation or apparatus in Toxotes to account for its extraordinary accomplishment. Let this be the occasion to point out, for the first time, the special anatomical and physiological features on which the shooting performance depends.

By carefully watching the fish at close range on many occasions in Siam, I formed an opinion of the probable propelling mechanism, and I subsequently verified that opinion by holding the fish in a basin or bucket of water in the position regularly assumed when shooting and making them perform almost at will. This was accomplished by the quick, forceful compression of the gill covers with my fingers. I was able to cause a fairly satisfactory imitation of the normal shooting act, and had no difficulty in propelling drops of water for distances up to three feet.

This compression of the gill covers would in itself not be adequate to account for the

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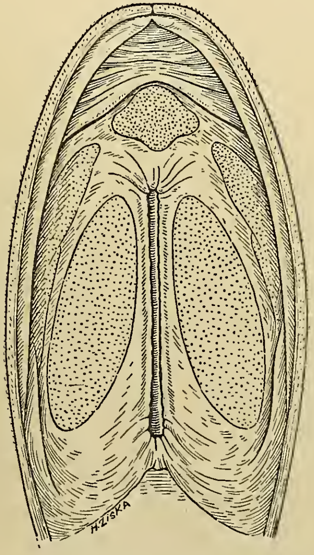
**Smithsonian Miscellaneous Collections*, vol. 52, part 3, p. 277-286.

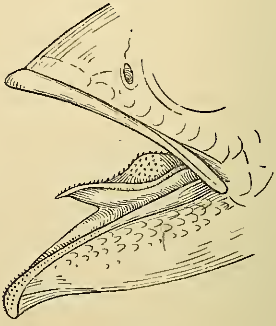
escape from the mouth of water in the form of individual drops of uniform size; and it is to the peculiar shape and structure of the mouth parts that we must look for the additional factors necessary for the complete and perfect performance.

The mouth cavity of Toxotes is long but its diameter is much restricted by the projecting sides of the roof and by the large tongue which when raised may completely close the passage from the outer air to the pharynx. The anterior part of the tongue is free from the floor of the mouth, and its rounded tip is of paper-like thinness and fits snugly against the palate; posteriorly the tongue is thick, bears minute teeth, and has a conspicuous fleshy prominence. Extending along the median line of the roof of the mouth, from a point just behind a band of vomerine teeth to the pharynx, are two low ridges, close together and parallel for most of their length, but slightly diverging at their posterior ends. Between the ridges is a deep groove which, when the tongue is applied to the roof of the mouth, becomes converted into a tube. This groove-tube, which in a fish seven inches long is less than a sixteenth of an inch in diameter, has not been previously described or referred to in ichthyological writings, but is readily seen when the tongue is depressed. That it should have been so long overlooked is something of a mystery when one recalls the vain efforts made by oriental ichthyologists to discover any special adaptation for drop-shooting.



"Blow-pipe" of Archer Fish

The groove-tube which enables the archer fish to project pellets of water from its mouth: a narrow slot in the roof of the mouth which is closed by the tongue



When the odd shaped tongue fits against the roof of the mouth a slender tube is formed, which is less than a sixteenth of an inch in diameter in a fish that is seven inches long

We are now ready to appreciate how the shooting fish operates. With the tongue closely pressed against the palate, the sudden compression of the gill covers will force water from the pharynx into the palatine canal; and with the tip of the tongue acting as a valve, the flow of water under pressure from the anterior end of the tube is regulated. It is the obvious habit of the fish to coördinate the compression of the gill covers with the momentary lifting of the tongue from the anterior end of the tube, permitting the escape of a single drop of water. With the jaws partly separated and the mouth reaching or projecting slightly above the surface, the drop of water is ejected with a force and for a distance that depend on the pressure. It is easy to understand how, with the pharyngeal cavity serving as both a reservoir for water ammunition and a compression chamber, it is possible for the fish to shoot drops of water in quick succession, as has been frequently observed, or the water may be expelled in the form of a jet when the valve is kept open longer.

Vision

The drop-propelling function would be useless if Toxotes did not possess, in addition, the ability to use its eyes in the air and to gauge accurately the distance, size, and suitability for food of small creatures flying or resting near the water's edge. It is an outstanding point that, for a fish, the aerial vision of Toxotes is very keen; and it was always a surprise to me to note the readiness with which insects and spiders were sighted as the fish explored the vegetation on the bank of a pond or stream.

The extent to which the fish's head projects at the surface of the water during the shooting act depends on circumstances. In muddy water the eyes must be at the surface in order to permit a good view and accurate aim; in clear water only the tip of jaws need project.

The chief accomplishment of the archer fish has been developed and is exercised in order to obtain living food consisting chiefly of insects. Enough has already been stated in regard to the general habit, but some definite references to food and feeding may be of interest.

This fish, with shapely, compressed body propelled by its broad caudal fin, is a graceful swimmer, moving quickly without apparent effort. It regularly swims at or just below the surface, and may go a long distance in a perfectly straight line, making a wake with the tip of its jaws. This wake is characteristic and enables an observer to detect the presence of a fish even before he has actually seen it.

The habit of swimming at the surface is ascribable to two circumstances: the food on which the fish chiefly subsists is obtainable there, and the eyes, on which the fish largely depends, could not otherwise function properly, for during most of the year the waters in which Toxotes lives are very muddy or turbid and aquatic vision is much restricted.

While Toxotes prefers the live food which it shoots for itself, it regularly eats shrimps, insect larvæ, and other creatures living in the water and insects that have fallen into the water. A large nest of carpenter ants impaled on a stake in a pond provided food for fish for several days as the ants fell into the water and were eagerly devoured. Under both semi-domesticated and wild conditions the fish does not reject bits of raw and cooked meat, fish, crabs and prawns; specimens which I had in a pond regularly came to be fed on raw chopped pork and fish.

In Siam, Toxotes is often sought by anglers, who use a light rod and line, armed with a small hook baited with a shrimp or insect. Favorite resorts for the fish—and hence for anglers—are the inlets and outlets of canals, near locks. A person in a small boat, casting his hook well away from the boat and doing nothing to frighten the fish, may often catch many at one place. The food value of the fish is high.

Toxotes versus a lizard

Once, in Bangkok, I saw a baby lizard, sunning itself on a vertical timber of a dock a few inches above the water, dislodged by a surprise shot of a Toxotes operating at point-blank range. As the lizard fell it was promptly grasped, but there may be doubt whether it was actually consumed. The cavity of this fish's mouth is too narrow and the sides are too rigid to permit the passage of a large mass of food; and it is apparent that seized insects and other food must first be reduced to a slender bolus between the tongue and the various bands of minute teeth on the roof of the mouth before swallowing is possible.

Some of the standard modern works of reference and text-books make inadequate or misleading allusion to the exercise of the shooting power. Thus, when the *Cambridge Natural History* states that "*Toxotes jaculator* derives its name from its habit of capturing insects flying over the surface of the water by shooting drops of water at them," it overlooks the much more common and characteristic habit of stalking insects that are resting on plants in the water or at the water's edge. In reality, insects shot on the wing represent a very small percentage of the total food intake. In Siam, Toxotes was very rarely noticed in pursuit of flying insects. On the few occasions when I observed this habit there had been an irruption of winged termites and the fish were very active in chasing the low-flying insects across a pond or water-course and directing a perfect barrage of shots if necessary to bring down the prey.

In "The Biology of Fishes" (1926), the author, H. M. Kyle, observed that "the taste for flies has become so great that one fish has developed into an expert sharp-shooter in stalking and smothering flies—with a drop of water and mucus." If "flies" can be interpreted as including ants, bees, termites, grasshoppers, moths, caterpillars, dragon-flies, beetles, cockroaches, ephemerids and many other kinds of insects, as well as spiders, the statement is correct with the exception that insects are not smothered and there is no mucus in the watery pellet.

Marksmanship

The range, accuracy, and force of the shooting powers of Toxotes always excite surprise and admiration. In my experience in Siam the distance within which the fish could always be depended on to score a direct hit was three and a half to four feet. A much longer effective range has been recorded. Two fishes in the New York Aquarium could without difficulty hit a small cockroach at a measured height of five feet above the water.

Failure to hit a resting insect within proper range may be due to movements of the vegetation or, in the case of a spider dangling on a thread, to swaying caused by wind. When the first shot misses a mark, other shots usually follow in quick succession.

The force with which the watery pellets may strike an object is sometimes most astonishing to a human observer. An insect may be knocked high in the air or may fall on the bank beyond a fish's reach. At short range the drops may strike a person's face with a distinctly stinging sensation. On many occasions, during exhibitions in Siam, a spider at the end of a thread hanging from the end of a pole was knocked far up on the thread or even over the pole. Spent shots could be heard to splash against the roof of a veranda over the water.

The shooting habit begins to develop early and may be observed in fish only an inch long. It it most amusing to see the inexperienced youngsters emulating the actions of their parents and sending out tiny drops which may go only two or three inches. In half-grown fish the habit is well developed, but the highest expression of the shooting powers as regards accuracy, force, and range is to be seen only in the fully matured fish.

A peculiar feeding trait was exhibited by both river fish and pond fish in Siam when a spider on a thread was lowered to within about one foot of the surface of the water. A fish, which may have been shooting at the spider when it was two or three feet distant, would with little apparent effort rise vertically from the water and seize the lure in its mouth, sometimes holding on when the line was raised several feet. This was done so readily and regularly as to suggest a normal habit, although as a matter of fact I never saw it tried on insects hovering near the surface or resting on plants. Probably spiders and caterpillars hanging from their threads are the principal victims of this method of attack.

The writer's acquaintance with this fish was formed in the Philippines, French Indochina, Siam, Malaya, Burma, and India, but chiefly in Siam where it is common over most of the country and is called *pla sua,* or tiger fish, in allusion to the black crossbands on the yellow sides. Wild fish planted in a large pond in the compound of my residence in Bangkok were under close observation for a number of years, and were a source of pleasure and instruction to myself and many foreign visitors and residents.

Intelligence

Among all the oriental fresh-water fishes with which I am acquainted in the wild state, none gives such an impression of intelligence and efficiency as does Toxotes. This impression grows on an observer as he notes the purposeful way in which a fish moves about in a stream, canal, or pond; the zeal and thoroughness with which it explores aquatic and overhanging land plants for insects; the high development of its sense of sight in both air and water; the skill displayed in dislodging insects and seizing them as they fall into the water; the alertness in avoiding danger; and the readiness in adapting itself to life in small ponds and responding to the attentions of persons who provide food.

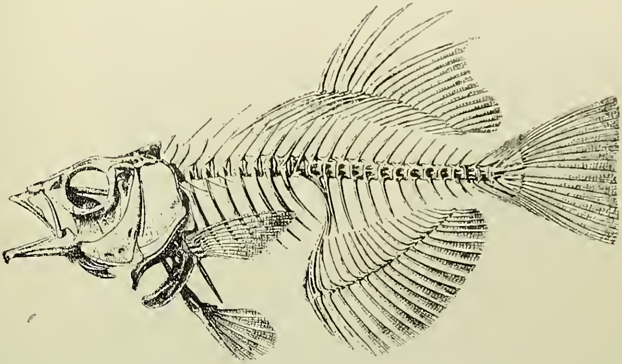
For the amusement of guests

A friend of mine, a distinguished scion of the royal family of Siam, and an ardent student of fishes, had a residence on the broad

Menam Chao Phya above Bangkok and used to entertain American and European guests with shooting-fish performances. A veranda on which he took many of his meals was directly over the water, and under it Toxotes could be found almost daily, attracted by scraps of fish, meat, chicken, and prawn which were regularly thrown from the table. By means of a spider or cricket dangled on a black thread from the end of a short bamboo pole, the shooting fish could readily be induced to display their marksmanship, and scores of foreign visitors, during the years I passed in Siam, were thus edified and amused. It was there that I sometimes saw spent watery pellets splash on the ceiling of the veranda ten to twelve feet above the river, and witnessed many other exhibitions which confirmed my respect for the intelligence and skill of Toxotes.

Carrying it too far

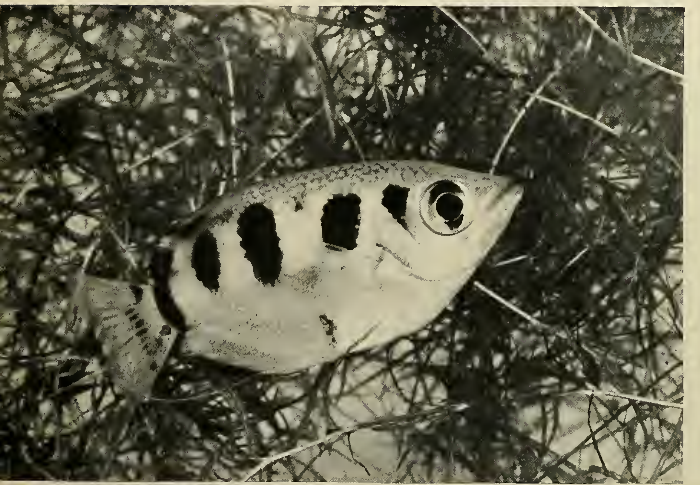
On two occasions to my personal knowledge, when my friend sat on the veranda eating his breakfast, reading a newspaper, smoking a cigaret, and apparently neglectful of his fish wards, his attention was attracted by well-directed shots which extinguished his cigaret.



Skeleton of Archer Fish (After Agassiz)

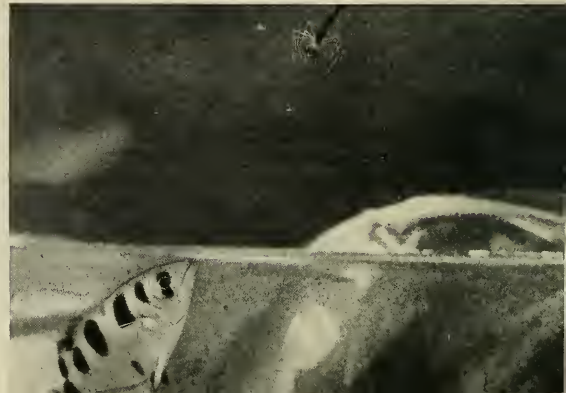
The Archer Fish

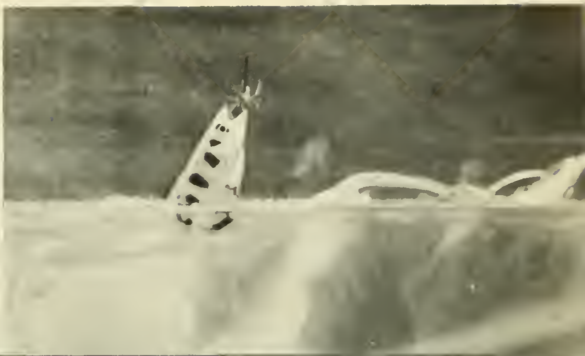
This curious fish makes its living by shooting insects with a drop or a short jet of water. Its aim is extremely accurate up to five feet, and if the drops strike one in the face at short range they produce a distinct stinging sensation. Shots that go wild carry ten to twelve feet. When maneuvering for a good position from which to "open fire," the fish frequently swims backwards; and its eyes, which are movable, sparkle with seeming intelligence. (It cannot definitely be stated that the specimen shown in these photographs is Toxotes jaculator, *the species commonly referred to.)*



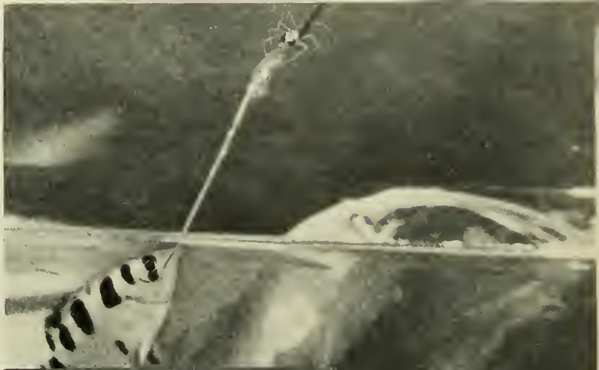
New York Aquarium, Dunton Photo

(Below) The archer fish preparing to shoot a spider



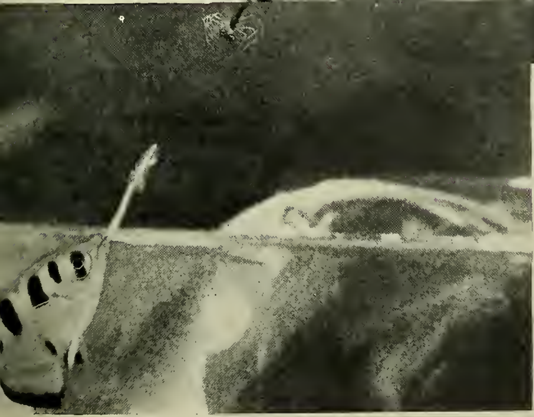


If the archer fish cannot get its prey in any other way, it will rise from the water and seize the insect in its mouth



An insect may be knocked high in the air, or may fall on the bank out of reach

The motion picture camera catches the shot in mid air

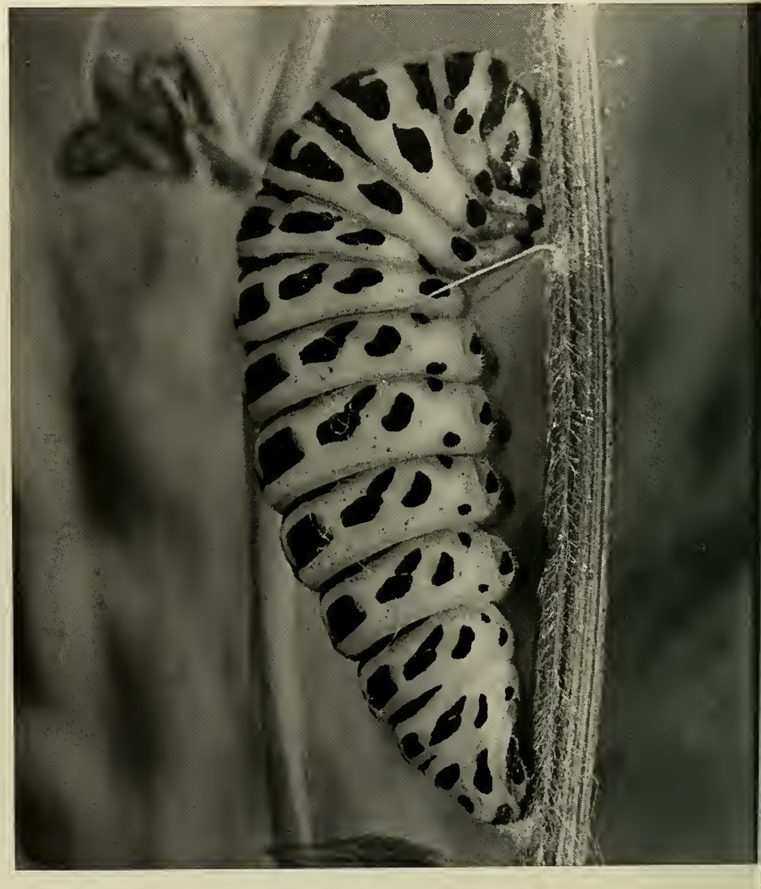


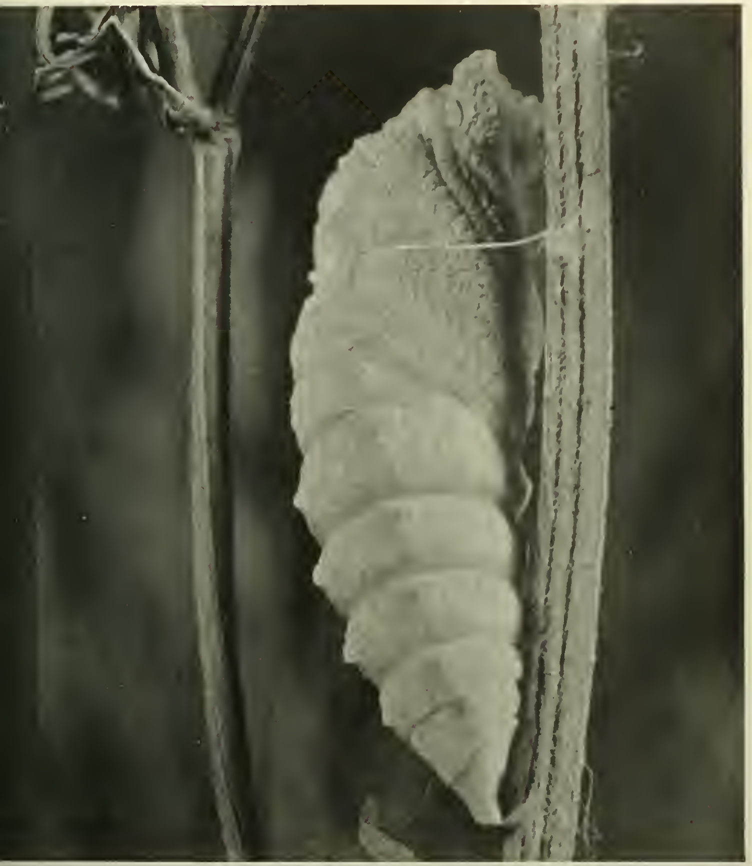
The author of the preceding article states that on at least two occasions to his knowledge a friend of his in Siam was sitting on his veranda beside a pool of archer fish, reading his newspaper and smoking an after-breakfast cigaret, when his attention was attracted by well-directed shots which extinguished his cigaret

tion photos by Pathé

Emergence of the Butterfly

In the following series of photographs the camera has enlarged the various stages in the development from the mature caterpillar to the adult butterfly. Although we show here the transition of a common European swallow-tail *(Papilio machaon),* the same changes take place in all butterflies. (The photographs employ more than one specimen to complete the sequence, but so regular is Nature that the substitution can scarcely be detected.)

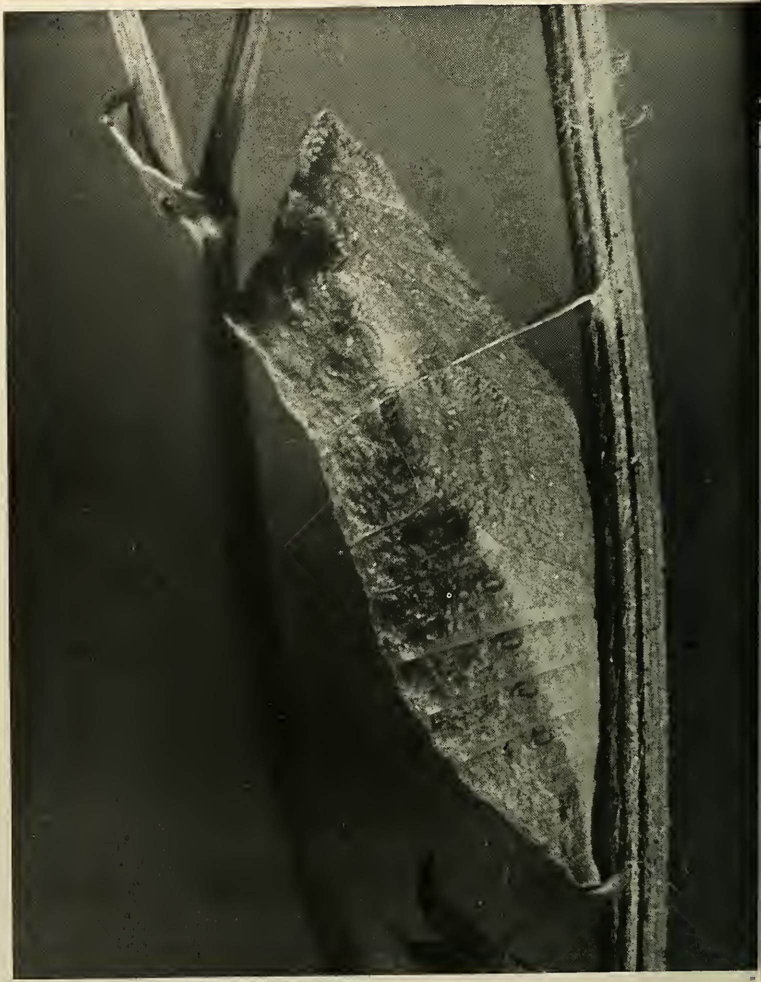




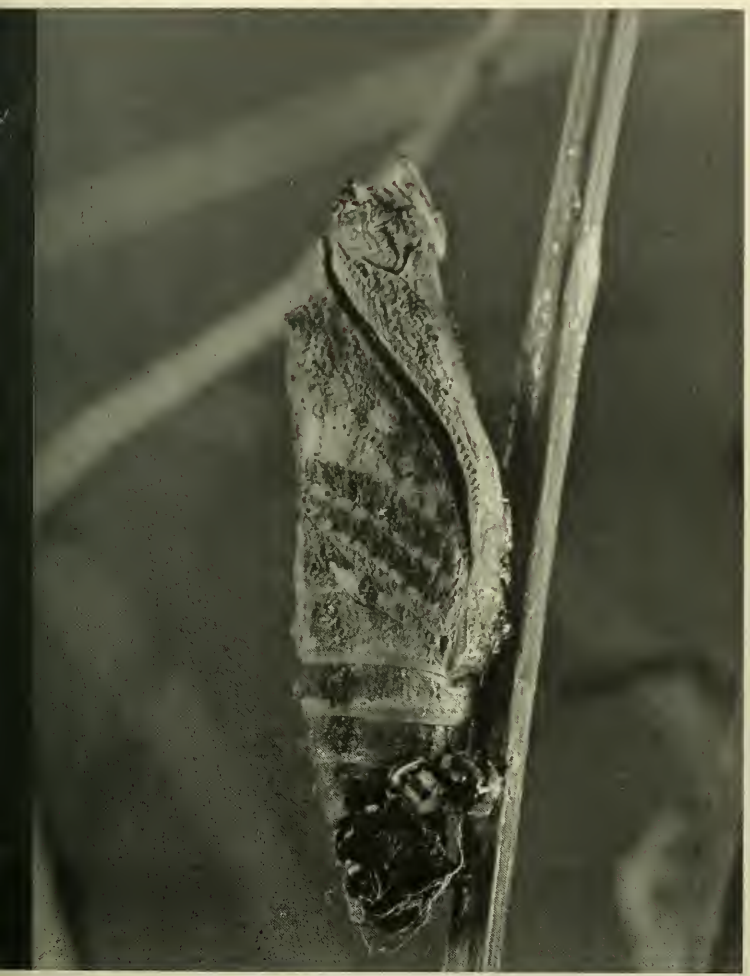
Photographs by Croy, from Black Star

(Left) The caterpillar has spent its time busily eating and has grown up enough to think of becoming a butterfly. It fastens itself by its tail to a plant by means of self-spun threads and thoughtfully provides a belt of the same material which is to prevent the pupa from changing its position. The actual length of the caterpillar is about an inch and a half

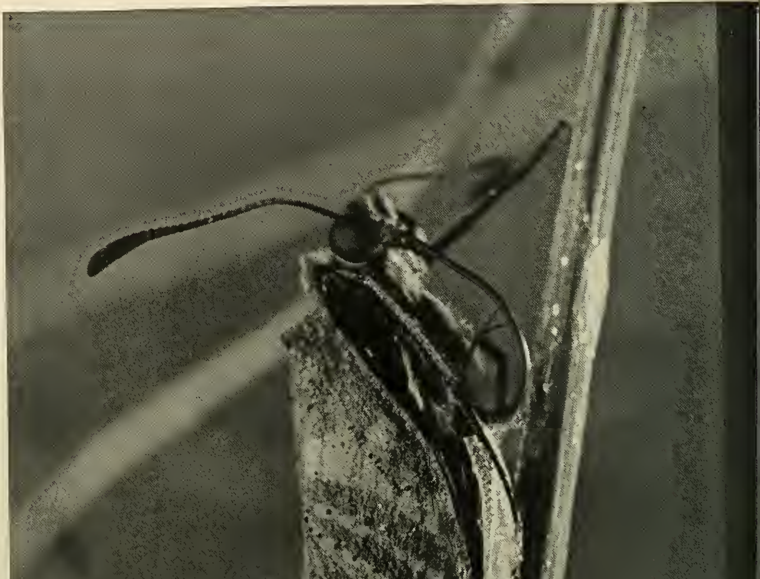
(Above) Shortly afterward the skin of the caterpillar splits open and the pupa emerges. Its shell is still soft and resembles the shape of the caterpillar



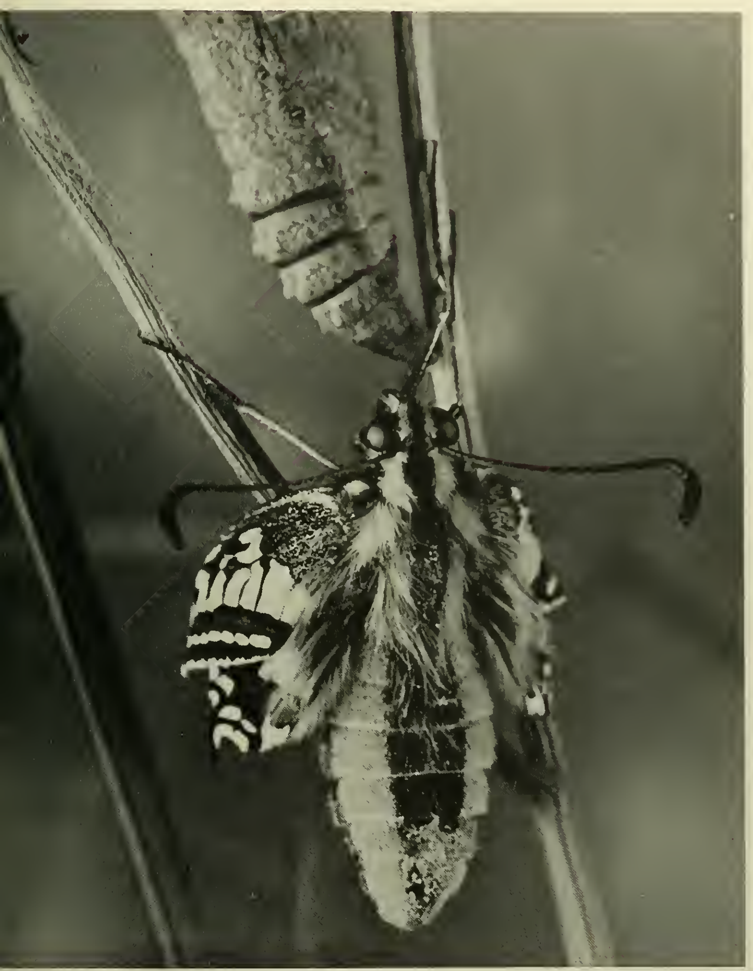
The pupa has acquired a hard shell which protects the soft interior where the change takes place. During this stage, that is so frequently referred to as the resting stage, all the internal organs of the caterpillar break down into a uniform liquid mass and then reform in the shape of a butterfly containing all the essential organs



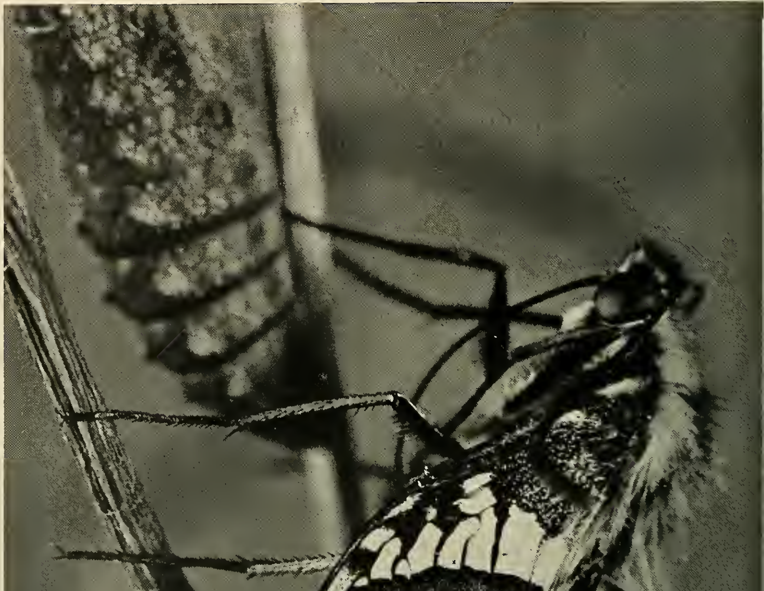
(Above) When the changes within the pupa are complete the hard shell bursts and the butterfly begins to emerge. The pattern of its wings are already discernible through the shell



(Above) The head piece is dropped and the butterfly sees daylight again in a new form
(Right) the butterfly is now freed, but

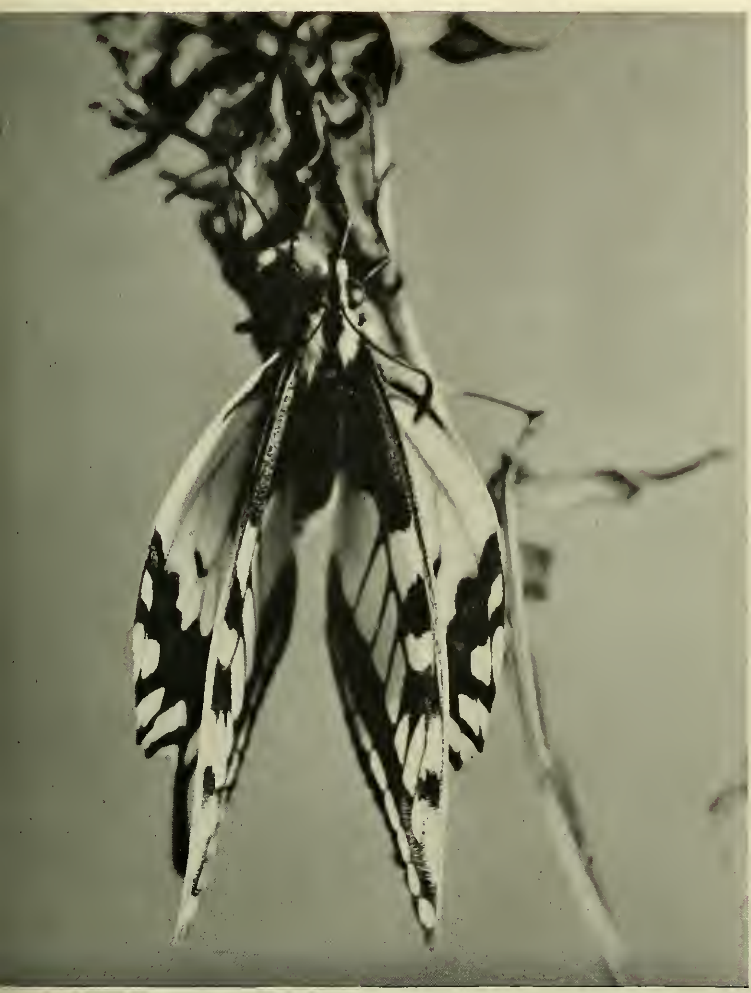


its wings are still soft little sacs of scale-covered membrane. These wing pads will be stretched to full size by the pumping of fluid into them

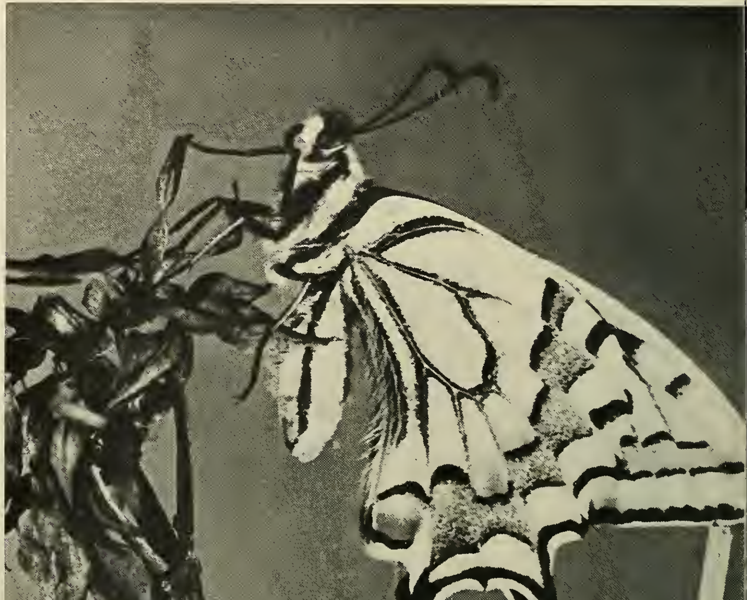


(Above) The wings blossom out quickly. From the time when the butterfly began to break out of the chrysalis until it has emerged and its wings are fully spread although not hardened is a matter of only twenty or thirty minutes

(Right) Before flight is possible the



wings must harden. They flutter spasmodically, probably hastening this process by increasing the rate of evaporation. The rate of hardening of the wings depends upon many conditions, including the size of the butterfly and humidity. Some small butterflies emerge and are able to fly in as little as ten minutes



The butterfly is fully developed, even the long tails of the wings are fully grown. It is a light yellow creature with black markings, and appears considerably larger than the inch and a half chrysalis from which it emerged

The Story of the Dinosaur Eggs

One of the epic tales of scientific exploration, told by a veteran of more than thirty expeditions

By WALTER GRANGER
Curator of Fossil Mammals, American Museum

THERE has recently been installed in the Mongolian exhibit at the Museum a group representing *Protoceratops,* the small hornless member of the horned dinosaur group, together with its nest of eggs. The two skeletons shown are real; the eggs are casts of a model made from a careful study of the Museum's collection of fifty more or less complete eggs, and they have been arranged in exactly the manner in which they occurred in one of the several nests discovered.

Behind the scenes

The finding of these dinosaur eggs has been told many times but it is an interesting story and will, perhaps, bear repetition at this time.

When the Central Asiatic Expedition first entered the Gobi, in 1922, it was not known definitely that dinosaurs laid eggs. Reptiles of today have both oviparous and viviparous methods of reproduction—even with closely related species of snakes some lay eggs and others bring forth living young, and it was supposed that since dinosaurs are reptiles, some of them, at least, might have laid eggs, although none had ever been found. At Rognac in southern France some fragments of what seemed to be reptilian egg shells were found in strata bearing dinosaur bones and there is a possibility that these are really bits of dinosaur eggs, but they may also belong to other contemporary reptiles. In North America, where dinosaurs flourished as nowhere else in the world and where their bones, their gizzard stones, their tracks and their toothmarks abound, not a trace of their eggs had ever come to light.

I presume that nearly every American collector of dinosaurs has been on the lookout for their eggs and has hoped that some day he might find one, or better still, a nest of them. I know that many times during the years I worked the dinosaur fields I visualized such a happening but as the years went on it began to seem such a remote possibility that it finally took its place as another futile day dream. In 1923, however, in the very heart of Mongolia, hundreds of miles from the nearest civilized community, this dream became a reality and we did find dinosaur eggs—not only single eggs but a whole nest of them, lying very much as the parent had left them seventy-five or more millions of years ago.

First dinosaur egg

The first discovery of these eggs came the year previous in 1922. On our way back to China in the autumn our party was passing near this locality, although not in actual sight of it, and the motor cars had been halted on the caravan trail to wait while the scout car ran off to the side to inquire the way at a Mongol village which we could see two or three miles distant. Taking advantage of this delay Mr. Shackelford, a photographer by profession but a fossil hunter by instinct, wandered off over the desert and soon came to the edge of the platform on which we had been traveling. He found that its face dropped off abruptly into a set of brick-red badlands, just the sort of place in which one learns to look for fossils. Climbing down into these rich-looking exposures, Shackelford was immediately confronted by a well preserved but somewhat weathered fossil skull with the jaws still attached and resting on a buttress of red sandstone. It was a simple matter for him to break the skull loose and he took it immediately back to the cars. It was identified at once as the skull of a reptile but its exact affinities were not determined until it was prepared in the Museum laboratory many months later.

This discovery seemed an important one to us and we decided to go into camp nearby and spend the remaining two hours of daylight in prospecting the locality. This prospecting resulted in the finding of many fragmentary remains of the same kind of animal. There was also picked up on the surface of the badlands a fragmentary and badly weathered egg shell which at the time was thought to be that of a bird, the eggs of which, although not common, are not really rare as fossils.

Later, when the bones collected that evening were determined at the Museum as belonging to a small member of the horned dinosaurs, it became evident that this badly broken and insignificant looking egg shell was actually the first positive dinosaur egg to be discovered.

Protoceratops andrewsi

The following year, realizing the full importance of these finds, we spent two months in scouring the area, named by us the Flaming Cliffs, with a large force of collectors, and we succeeded in obtaining several skeletons and more than fifty skulls of the little dinosaur which had already received the name of *Protoceratops andrewsi.* Of its eggs there were found many individual specimens mostly weathered out and lying on the surface, remnants of two or three nests where the erosion had left us only a small part of the original "clutch" of eggs and one nest where the erosion had only begun to make inroads and the greater part of the nest with no less than fifteen eggs was still intact. That was a great season for dinosaur eggs and while the scientific importance of the discovery was perhaps not so great as other discoveries made that year it did meet at once with popular fancy and did more than anything else to give the Central Asiatic Expedition public recognition the world over.

It may properly be asked, how do we know these are dinosaur eggs and how do we know they belong to this particular type of dinosaur known as *Protoceratops?* The answer is this: In the very limited area of Upper Cretaceous exposures at Flaming Cliffs extending along the face of the tableland for five or six miles we found upwards of fifty more or less complete eggs and thousands of egg shell fragments representing at least several hundred more eggs. They were to be found everywhere from one end of the exposures to the other and throughout the one hundred and fifty feet thickness of the deposit. *Protoceratops* was also very common and its bones were everywhere, frequently in close association with the egg shells. There were a few other types of dinosaurs found there but they were very rare and of types too small and delicate to have laid any but the smallest eggs found. Reptiles, other than dinosaurs found in the deposit, are a single tiny crocodile and a few small aquatic turtles—both out of the question as possible parents of the eggs.

It seems reasonable, therefore, to assume that the greater number of these eggs belong to *Protoceratops.* The eggs are of the right size, they have been found in close association and there are no other animals of this fauna, so far as known, to which they could properly be attributed.

The eggs which we have assigned to this diminutive ceratopsian vary from five to eight inches in length. In shape they are long ovate, an unusual shape for modern reptile eggs which are usually oval or spherical. The eggs are smooth at either end but the rest of the surface is covered with a fine irregular wrinkling as seen in the photograph of the single egg. The shells were undoubtedly brittle because all show more or less cracking which would hardly have been the case if they had been leathery, as some reptile's eggs are. In all cases the egg shells are filled with the same material in which they are embedded—fine-grained sand which had evidently filtered in after the shells became cracked, and had replaced the soft contents of the shell.

Why Outer Mongolia?

The question naturally arises as to why dinosaur eggs should be found in abundance in one restricted area in Outer Mongolia and nowhere else in the world, barring possibly the fragments of shells from France and a few other fragments recently discovered by Princeton parties in northern Wyoming. The only satisfactory explanation is to be found in the nature of the strata in which these Mongolian eggs occur. The deposit is a uniform, brick-red, fine-grained sandstone, so soft that it can easily be dug away with the finger nail. The geologists assured us that it was an aeolian deposit: that is, one laid down as wind-blown sand. At the time *Protoceratops* lived there it was evidently an area of drifting sand with probably a few small streams or ponds as indicated by the presence of the crocodile and the aquatic turtles. This then would account not only for the deposition of the eggs but for their preservation during the subsequent millions of years.

Eggs laid in circles

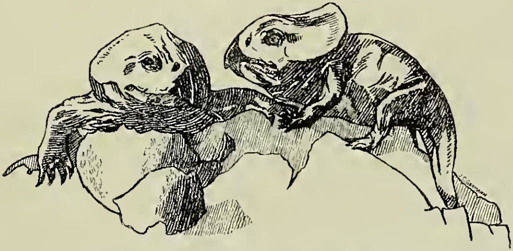
Sea turtles, of our time, come out of the water at night, climb up above high tide and there deposit their eggs in a pit in the sand and then after covering them carefully return to the sea, leaving the eggs to hatch by the heat of the sun. And so it is not difficult to visualize the female *Protoceratops* coming into the sand dune area, digging a pit and there depositing her twenty to thirty eggs at one time, covering them up and allowing the warmth of the sun to incubate them.

If one may judge from the several nests found, the arrangement of the eggs in the nest was always the same. They were in circles with the large ends up and tilted toward the center. In the case of the most complete nest discovered—the one used as a model for the group—there were five eggs in the lowermost circle and slightly above this was a much larger circle of eleven eggs. Still higher were the tips of two eggs indicating that there had been a third circle which if complete would have comprised about twenty eggs. The erosion of recent time, however, which had already removed the hundred or more feet of overlying sandstone, had reached the nest before the fossil collector came along and had sheared off the upper ends of most of the eggs and had very probably removed entirely all but two of the eggs of the uppermost circle. At any rate there were eighteen eggs represented and it is not unlikely that the nest originally contained thirty or more eggs. In another nest the erosion, working on a vertical face, had cut away just half of the eggs leaving fifteen still in the bank.

The orderly arrangement of the eggs in the nests may have been brought about by adjustment with the front feet or the beak, but it seems more reasonable to suppose that the female simply rotated her body as the eggs were deposited. The shape of the pit, being smaller at the bottom, would, of course, automatically regulate the diameter of the various circles of eggs.

75,000,000 years later

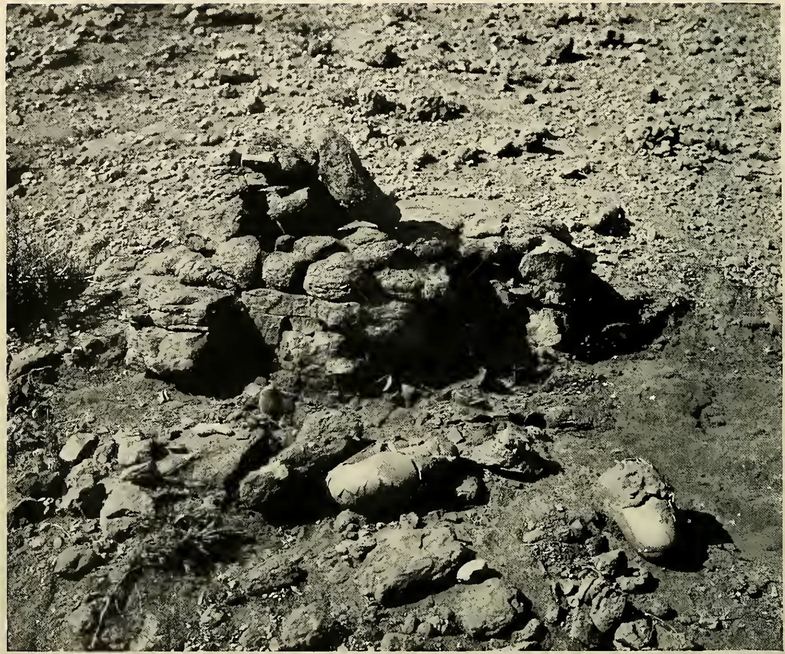
Obviously none of the complete eggs found had hatched, although two isolated eggs picked up on the surface do show what appear to be traces of highly developed embryos. It is quite possible that there may have been a sudden accumulation of drifting sand on top of the nest, which, if not sufficient to crush the eggs, would at least have cut off the heat of the sun and so stopped incubation, or there may have been other reasons which we cannot readily conceive. Whatever the reasons are, however, we are grateful for them because these particular nests, failures in the eyes of nature, have been handed down through seventy-five million years of geologic time to assist us materially in interpreting the life of that time and place.



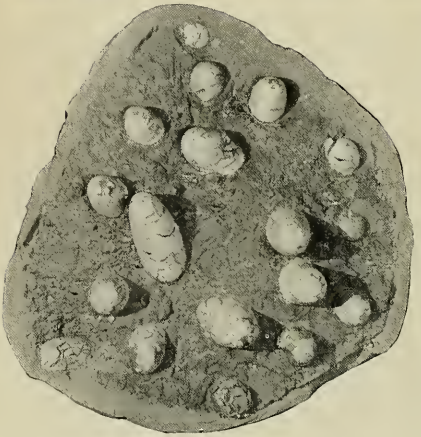
Baby dinosaurs emerging from the eggs

Drawing by John C. Germann from model by Mrs. E. Rungius Fulda

The Story of the

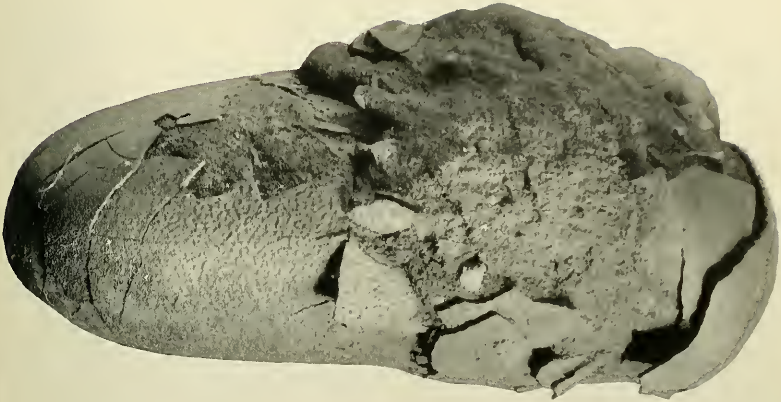


(*Above*) *The first dinosaur nest discovered. One-half of the original nest of about thirty eggs was found under the sandstone mound; the other half had been eroded away but the eggs seen in the foreground had resisted the disintegrating process*



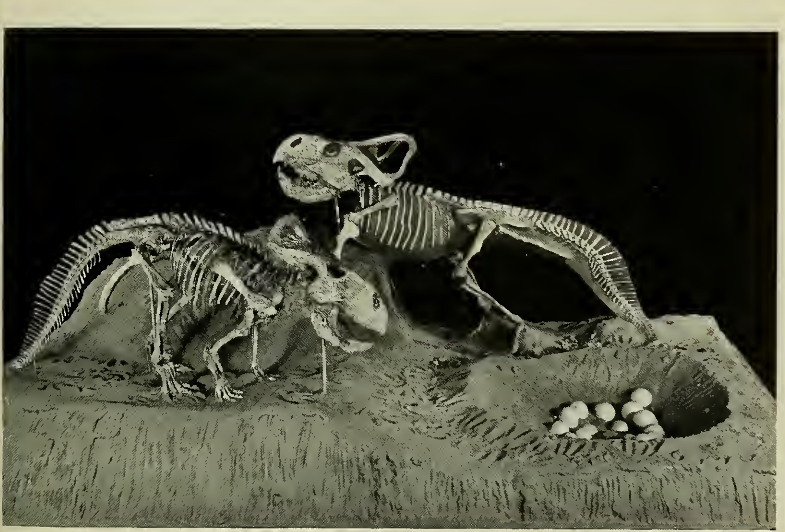
(*Left*) *The underside of a nearly complete nest with the eggs still in position but worked out in high relief. Note an inner circle of five eggs and an outer circle of eleven eggs with the remnants of a third circle*

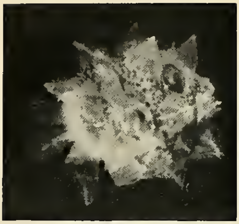
Dinosaur Eggs



(Above) 75 million years old. Filled with a fine-grain sand in which it was embedded, this egg, smooth on both ends, has the rest of its surface covered with a fine irregular wrinkling

(Below) The newly installed Protoceratops *group. The skeleton in the background was prepared and mounted by the late Peter C. Kaisen; the other skeleton was mounted by Charles J. Lang who also assembled the group*

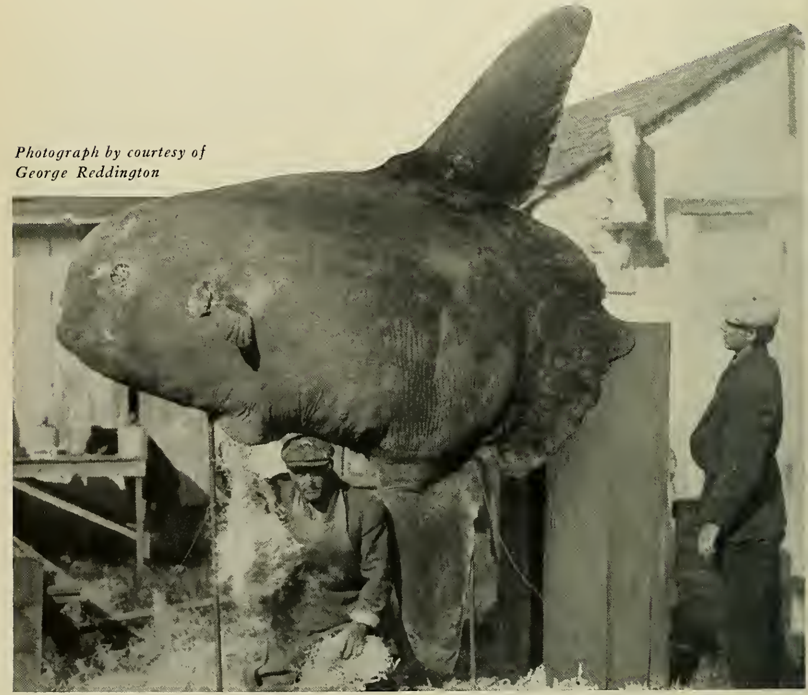




Photograph by courtesy of A. Vedel Taning

(Above) The 1/10 inch larva of the pointed-tailed ocean sunfish: a speck of living matter from which the ten-foot colossus of the sea shown below developed. The tiny larva is a free swimming creature, able to find its own food. The comparisons which the author of the interesting article opposite draws, gives this fish a good claim to the title of growth-champion among animals

Photograph by courtesy of George Reddington



From Atom to Colossus

Growth of the pointed-tailed ocean sunfish from one-tenth inch to ten feet,—an increase of 60,000,000 times its original weight

By E. W. GUDGER
Associate Curator of Fishes, American Museum

THE attention of New Yorkers in particular and of the readers of the metropolitan press in general has recently been called to the birth of a little bear cub in the Brooklyn "Zoo." This small chap was about 6 inches long and weighed 12 ounces. The mother probably measured 5½ feet from snout-point to tail-tip, and weighed about 200 pounds—these being the sizes for an average female bear.

Comparison among mammals

It has been estimated that a cub ordinarily equals about one two-hundredth of the weight of the mother bear; a puppy about one twenty-fifth as much as the mother; and a human baby about one-twentieth. In all these cases there is great discrepancy in size between baby and mother, but greatest in the bears.

This infantile descendant of the genus *Ursus* was in the course of nature born blind and hairless, and looking very unlike the bear he will grow up to be. Hence the fiction that the mother "licks the cub into shape"—a saying which by extension has come to be applied in a figurative sense to the young of the genus *Homo.*

The little cub referred to (and he was not only a cub but he *was* little) was taken from his mother and at first fed with a medicine dropper. Later, when he had grown a bit, he appeared in the news-reels as a bottle-fed baby who made strenuous remarks when his bottle was not forthcoming.

Most large animals give birth to large young, and contrariwise most small ones to small young—whether mammals or fish. But before considering the most unusual case in the fishes, and perhaps the most extraordinary in the animal kingdom, let us turn for a moment to a most interesting land-dwelling mother and baby, the difference in whose sizes is very great.

The contrast between the just-born kangaroolet and the mother is tremendous—in fact it is probably greater than that in any other land-living animal. The average mother kangaroo is three feet from crown of head to root of tail, while the baby, or "Joey" that is to be, has a similar measurement of about an inch. The mother weighs about 100 pounds (1600 ounces), the infant a mere fraction of an ounce. The young kangaroo is born in a condition even more unformed and more unlike the mother than is the baby bear. This in part at least accounts for the great disparity in size of mother kangaroo and her kangaroolet.

But great as is the contrast between the just-born kangaroo infant and the adult into which it will grow, a far greater difference is now to be considered—probably the greatest for any member of the animal kingdom living today. I refer to the contrast in the ocean sunfishes—young and adult.

The ocean sunfishes

To many of my readers the name sunfish calls to memory the little short-bodied perch-like fish of our fresh-water lakes and streams. These lovely little fishes are of at least half a dozen kinds and are perhaps our most common fishes angled for by every boy. But the pointed-tailed ocean fellow is not only a sea-dweller but is infinitely smaller when he is small and vastly larger when he is large—as we shall see.

The ocean sunfishes are millstone-shaped fishes and for that reason have been given the family name Molidae. Two of them, *Mola* and *Masturus,* grow to a size in which length (over the tail-fin) and depth (over the dorsal and anal fins) amount each to more than 10 feet, and they attain to a weight of from one-half to three-quarters of a ton. They are the largest fishes with the smallest eggs and littlest babies known to me. Yet it must be noted that, unlike baby bears and kangaroos, their microscopic young when hatched out of the floating eggs are born into the waste of waters able to seek and find their own food—to fend for themselves.

The smallest pointed-tail

Among the treasures gathered, by the Danish "Dana" Expedition of 1920, from the Sargasso Sea, that great "dead water" of the North Atlantic Ocean, is the smallest pointed-tail ever recorded. This we owe to that master deep-sea oceanographer and ichthyologist, the late Johannes Schmidt of the Marinbiologisk Laboratorium in Copenhagen.

The little fish shown in the figure is only about one-tenth of an inch long. The illustration is made from a photograph obtained by placing the tiny fish under a microscope. On the printed page, the fishlet is enlarged 10 times. It is what ichthyologists call a larval fish—that is, one quite unlike the adult, and which must undergo some extensive transformations in the course of its life history in order to become an adult.

To get an idea how tremendously small (the phrase is justified) this little fish really is, let the reader get out a foot-rule and look at an inch-space marked on this. This inch will be divided into both eighths and sixteenths. The little fish shown in the figure is larger than one-sixteenth but smaller than one-eighth of an inch. In fact it is about the size of a capital O in this type. It is the smallest free-swimming larva of any large fish known to me. It controverts the general rule that large animals have large eggs and young.

Our fish are called pointed-tails, but it is clear that there is nothing pointed in the tail of the microscopic larva. The dorsal and anal fins are very like those of the adult, but, instead of the central spade-shaped lobe of the colossus in the figure, in the baby the body ends like that of an ordinary young bony fish—in a stout stump with a paddle-shaped fin on the end.

But our pointed-tailed fish is *not* an ordinary fish, and in size and form the tails in the two ages are as far apart as the antipodes and as unlike as are the sizes and shapes of the two fish. The tale of how the tail of the little sunfish disappears and how the great and unwieldy tail-end of the adult *Masturus* comes into being, a tail-structure found in no group of fishes save the Molidae, or mill-stone fishes, is indeed "another story" which will be told in a technical article in another place.

The giant of the tribe of *Masturus* of the whole world is shown in the large photograph. For this photograph I am indebted to Mr. George Reddington of St. Augustine, Florida, in whose "Museum of Marine Curiosities" on Anastasia Island the fish is on exhibition. The readers of Natural History who go to Florida may at any time see it there.

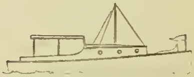
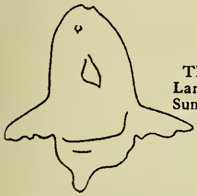
The colossus

This colossus among pointed-tails came ashore at St. Augustine Beach in 1912. There is today no definite record of its measurements, but Mr. Reddington has it that it was over 10 feet in length to the tip of the caudal "spade" as some call it, and 11 feet 3 inches deep over the great dorsal and anal fins. One can well believe this by comparing the height of the standing man with that of the fish. Today, after 24 years of drying and shrinking, the mounted fish measures 8 feet long and 9 feet 7 inches deep.

When fresh, this gigantic creature was too heavy and too unwieldy to be hoisted for weighing, but its weight was *estimated* at about 1700 pounds. This is probably too high a figure. But judging by my records of somewhat smaller specimens which were *weighed,* it seems likely that this great fish must surely have tipped the scales at over 1200 pounds. It is the largest and heaviest pointed-tail on record, a veritable giant.

Lest anyone think that this fish was a freak in size, it may be of interest to note that the next largest on record (also a Florida specimen, captured in a net off Daytona Beach in April, 1931) measured 8 feet 4 inches in length and the total depth was 8 feet 9 inches. Its great tail-fin, measured from the body

A CHART OF RATIOS TO SHOW BY COMPARISON WITH OTHER LIVING CREATURES THE PHENOMENAL GROWTH OF THE LARVA OF THE POINTED-TAILED OCEAN SUNFISH

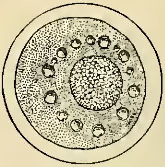
	A Child At Birth	is to	Its Mother	as	A 150-lb. Rowboat	is to	A Life Boat (3000 lbs.)
	A Puppy At Birth	is to	Its Mother	as	A 150-lb. Rowboat	is to	A Fishing Launch (3750 lbs.)
	A Cub At Birth	is to	Its Mother	as	A 150-lb. Rowboat	is to	A 36-ft. Cruiser  (30,000 lbs.)
	A "Joey" At Birth	is to	Its Mother	as	A 150-lb. Rowboat	is to	An Ocean-Going Tug (240,000 lbs.)
	The Larval Sunfish	is to	Its Mother	as	A 150-lb. Rowboat	is to	60 Queen Marys (The Queen Mary's Tonnage 80,773)

proper to the tip, was 2 feet 2 inches long. The lower side of the tail-lobe had suffered mutilation.

As the figure shows, the St. Augustine giant has a short rounded caudal lobe which has evidently been abbreviated. Examination of all published figures shows that almost all recorded adult specimens of this fish have mutilated tails. These sluggish and defenseless fish are readily attacked by sharks and barracudas, and the caudal lobe is the part most vulnerable and most often mutilated. Attention is called to the spots found on the great tail-fin. In almost all perfectly fresh specimens of the adult *Masturus* the body also is more or less covered with spots.

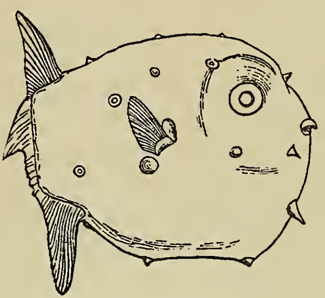
The egg

The reader has seen from what a microscopic larva (only about one-tenth of an inch long) our 10-foot colossus of the pointed-tailed tribe has grown. It would be interesting to know the size of the egg from which the larva of *Masturus* has developed. So far as I know no figure of such an egg has ever been published. But Johannes Schmidt has figured the egg of the first cousin of the pointed-tail, that of the truncate-tailed sunfish. This, shown in the annexed figure, was about one-twentieth of an inch in diameter—about half the size of a small letter o of this type. The fishlet which Schmidt hatched from this egg, when in the same stage of its life-history as our little fish, was practically of the same size and make-up as ours. I know of no other large fish which lays an egg anything like so small as this.



The egg of the truncate-tailed ocean sunfish, a cousin of the pointed-tailed fellow which grows so large. The natural size of this egg is about 1/20th of an inch in diameter. Here it is enlarged about 20 times.
(*After Johannes Schmidt*)

From all this it can be judged that the 10-foot colossus, shown in the large figure, developed from an egg about one-twentieth of an inch in diameter. What a prodigious amount of eating our great fish must have done! What its food is we do not surely know. This was long thought to consist of marine algae, but now the fish is known to feed in part upon the small transparent paper-thin larvae of the eel. But these are very small and likewise few and far between in the vast ocean. *Masturus* is, along with its cousins *Mola* and *Ranzania,* just about the poorest swimmer in the seven seas. Where and how it can find the larger and more abundant food out of which to develop its huge bulk, is one of the unsolved problems of the piscine world. With Shakespeare we may surely ask "Upon what meat hath this our Caesar fed that he hath grown so great?"



A 1¼ inch sunfish: a mid-way specimen which helped scientists to identify the "atom" as the offspring of the "colossus." Most such specimens are found in the stomachs of predatory fish; this one came from a kingfish in the middle of the South Pacific
(*After Günther*)

Islands West of South America

Further explorations on the schooner "Zaca."—To Selkirk's Juan Fernández, the rainless guano islands of Peru, and exotic Galápagos

By JAMES P. CHAPIN

Associate Curator, Continental Old World Birds, American Museum

OFF the coast of Central Chile, a little more than four hundred miles out, lie the Juan Fernández Islands. The "Zaca," on her return from Easter Island,[1] had over fourteen hundred miles of ocean to cross before reaching Mas Afuera, the outer island of the group. With the good weather we now enjoyed, this was a voyage of ten days. Various occupations made them pass pleasantly.

A few birds in the ice-box still had to be skinned. We could watch the sailors as they fished from the bow for bonitos, small cousins of the tuna, which swam abreast of the ship. Jaques and I could always scan the water for birds, seeing petrels of several species, an occasional red-tailed tropic bird, or a solitary gray noddy. We even hoped to see an albatross, but it soon became evident that they remain well to the south of the 30th parallel, except in the cold waters close to the South American coast. Our last red-tailed tropic-bird, characteristic Polynesian species, was noted about 440 miles west of Mas Afuera. From there on we were in American waters.

Landfall

The morning we approached Mas Afuera its high southern extremity, rising to some 5400 feet, was capped with clouds. Here was an island as precipitous as any of the Marquesas, with gray cliffs and grassy taluses, where numbers of goats could be seen grazing. The upper levels on the mountains showed a good deal of green bushy growth, but could scarcely be called well wooded, and the shores of the island seemed rather dry.

Its whole length is only eight miles, and we were soon anchored off the east side, opposite the old penal colony, abandoned some five years previous. I could not help contrasting our enthusiastic visit of a day with the enforced residence of those who had occupied the ten low buildings we found marked as offices, workshops, and *calabozos*. The headquarters of the *carabineros* suggested that the guardians may not have been much happier than the prisoners.

In such a place enthusiasm must vary inversely as the length of sojourn. In my case the only anxiety was to see as much as possible in so short a time. We knew that petrels must nest in burrows up on the mountains, and that there were several land birds: a large hawk, a hummingbird, a brown thrush, and two small brown birds of other South American families.

Island hawks

The hawks did not keep us waiting. Before we reached the landing-place two of them were seen flying about a large pine tree planted close to the buildings. Several more were found later, and although *Buteo polyosoma* is related to our North American red-tailed hawk, its representatives on Mas Afuera had no great fear of man.

Back of the penal colony a narrow valley, or rather a great gorge, extended inland. The brook in it had dried up to a series of stagnant pools, and about the rocks along it lived *Cinclodes oustaleti,* thrush-like in appearance but belonging near the oven-birds. Jaques and Doctor Lyman offered to cover this valley, while with Jack, one of the Norwegian sailors, I was to take the zigzag road up the ridge on the north.

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[1] This is the third and concluding article by Doctor Chapin, describing the Templeton Crocker Expedition to the South Pacific. Previous articles appeared in *Natural History* for November, 1935, and April, 1936.

What I sought were woods in which the other birds might find shelter. We climbed 1500 feet before the grasses became interrupted by huge ferns, like tree-ferns without trunks. A little later the path veered to the right and traversed a gully filled with the low woods we had seen from below. In such moist places there were also typical tree-ferns with trunks fifteen feet high. A tangled "maqui" tree with small purplish berries attracted a pair of thrushes (*Turdus falcklandii*), but I failed to find either the hummingbird or the spiny-tailed *Aphrastura masafuerae.*

Petrel nests

As we climbed higher through these woods we began to see the burrows of gadfly petrels. Great numbers of the birds had been seen over the ocean at daybreak, and here were their homes. Jack dug out a few of the holes without finding any occupied, but several dried carcasses lying near by were readily identified as *Pterodroma externa.* Another smaller species, *P. leucoptera,* is likewise known to nest on the island, probably at a higher level.

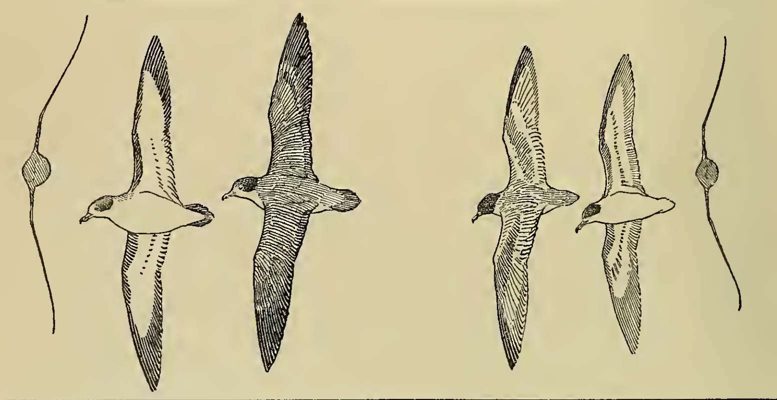
After crossing several wooded gullies, the trail ended near a rough shack with a corrugated iron roof. Inside, the ashes of a fire seemed not more than a few months old, and I felt as though I had stumbled on the abode of Robinson Crusoe. This camp was probably used occasionally by goat-hunters from Mas Atierra.

We walked uphill through open groves of trees with grass beneath, until these woods ended at 2200 feet. Above that there were clumps of tough ferns, four or five feet high, and a few tree-ferns with short fronds. As far up as we could see, ferns dominated the landscape. Looking down into a moist ravine, Jack spied some foliage like giant rhubarb leaves, five feet broad, with stems at least six feet long. So we climbed down to where these amazing leaves grew from a fleshy trunk that seemed covered with shaggy red hair. *Gunnera peltata* is a justly celebrated plant, and though native only to the Juan Fernández Islands, it has been grown widely in botanic gardens.

Off for Mas Atierra

To get down to the landing-place took little over an hour, and by five in the afternoon we were sailing away. Soon we were surrounded by the evening assembly of petrels, hundreds of them sailing low over the water, as they prepared to revisit their nests. The sun set directly back of the deserted prison-island, and we headed for Mas Atierra.

A schooner sighted shortly after midnight,



Two of the common Pacific types of gadfly petrel (Pterodroma), showing the upper and lower surfaces as they are seen when "banking" in the wind the second ship seen out of sight of land since we left California, was bound in the opposite direction on a fishing or hunting trip to Mas Afuera.

Early next morning Mas Atierra and its smaller neighbor, Santa Clara Island, were in plain view on a smooth ocean, with petrels of several kinds as well as shearwaters in view. At first these islands looked even more arid than Mas Afuera. As we approached the northern corner of Mas Atierra there were high cliffs, and then the Sugarloaf, a 2000-foot mountain with a tiny cap of woods and a few of the indigenous *Juania* palms.

A real Robinson Crusoe

Beyond Sugarloaf was a small bay with a cave in the rock near shore—Selkirk's Cave. It was here that Alexander Selkirk was put ashore in 1704, to live alone for four years and four months, and thus to provide Defoe with material for *Robinson Crusoe.* While the lower ends of the valleys still looked very dry, extensive woods could be seen inland at the bases of the mountains. There the island is far more richly wooded than any part of Mas Afuera.

Finally we came abreast of the village of San Juan Bautista, where a large white building on the shore was the headquarters of an important lobster company. The catch is shipped to Valparaiso. Behind the village rose mountains the highest of which is known as "El Yunque" in allusion to its anvil form. The higher end rises a little over 3000 feet.

Hugo Weber, one of the crew of the "Dresden," sunk in this harbor during the World War, came back with his wife a few years ago to live on a farm near the base of El Yunque. My day was spent in an excursion to Weber's farm, a clearing surrounded by beautiful forest; and there I met Charles Bock, a veteran collector of birds and plants. Our road led up through woods at first composed largely of "maqui" trees, introduced from South America, and now spreading with dangerous rapidity. Just before reaching the farm we came into the indigenous forest, with large trees of many species and undergrowth rich in ferns.

About the Weber's home were flower gardens that attract hummingbirds, especially the smaller green *Sephanoides sephaniodes.* Along a path at the edge of the woods we began to see the larger *Thaumaste fernandensis,* the species which had eluded us on Mas Afuera. The males are largely rufous, the females glossy green above, whitish beneath. Unless forewarned one would take them for two distinct kinds of hummingbirds. A favorite tree with this bird was *Raphithamnus venustus,* full of small tubular blue flowers. Whenever we noticed such fallen flowers, we would almost certainly find the hummers chasing each other or feeding overhead.

In swampy places in the woods Mr. Bock showed us a splendid patch of *Gunnera* plants, and likewise some of the rarer examples of the flora which he had transplanted from the higher mountains. Mas Atierra is an island to arouse the enthusiasm of a botanist.

As we left our anchorage early the next morning a school of six or eight killer whales escorted us for ten minutes or more. Two and a half days of very easy going brought us within view of the Andes, and only a few hours before we sighted South America Jaques saw the first albatross. It was near the same place, too, that small flocks of phalaropes began to show themselves. Probably of the species called the red phalarope, they were in gray-and-white winter plumage, looking for all the world like sanderlings when in flight. These lobe-footed shorebirds breed in the Arctic and then seek the southern summer at sea, even beyond the Tropic of Capricorn.

Birds of the cold current

We had almost failed to appreciate the narrowness of the fringe of cold water welling up in the Humboldt Current. The morning of February 4, 1935, we arose at daybreak to see the peak of Aconcagua, and in two hours were off the harbor of Valparaiso. The skuas, gulls, terns, pelicans, cormorants, and boobies characteristic of the cold water seemed almost to hug the shore. They all showed up when I was below, shaving, to Jaques' great amusement.

At Valparaiso we were back again in civilization—strikingly so. The influence of climate on human society here finds eloquent expression. Moreover, we were among friends. Local naturalists and American consular officials greeted us warmly, the press pictured us on the front page. We tied up alongside Mr. W. K. Vanderbilt's yacht "Alva," and I met my old friend William Belanske, his artist-preparator. A little farther along the mole was the Chilean training ship "Almirante Baquedano," the name of which we had seen painted on the Easter Island statues.

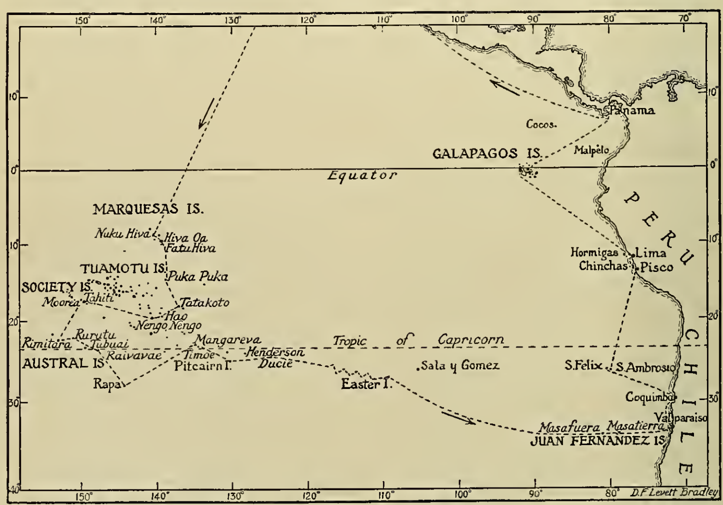
Our stay of eight days in Chile would deserve an article in itself. Suffice it to say that Mr. Crocker, Doctor Shapiro, and Mr. Jaques visited Santiago, and then Jaques and I made a two-day trip by train and auto to the Argentine frontier. From the base of the statue of Christ the Redeemer on a cold Andean pass we gazed upon the snowy summit of Aconcagua. In the afternoon Lincoln Ellsworth flew over us in a passenger plane from Mendoza to Santiago.

At Valparaiso we bade goodbye to Doctor Shapiro, whose work had been completed. Henceforth we would confine our attention to islands of no anthropological interest, but we were sorry to lose his ever-cheerful companionship.

If I was disappointed at seeing so few of the Humboldt Current birds before reaching Valparaiso, I had no regrets as the "Zaca" bore us northward along the coast to Coquimbo. Now we met the albatrosses, diving petrels, large skuas, black-backed kelp gulls, gray gulls, Inca terns, brown pelicans, guanay and red-footed cormorants, and Peruvian boobies. These are only the common species of the assemblage described so masterfully in Dr. R. C. Murphy's *Bird Islands of Peru.*

Coquimbo was our point of departure for the barren volcanic islands of the San Felix group, lying about 400 miles off the coast of northern Chile, near latitude 26° S. After a single night at sea no more cold-water birds were visible, and we began to see petrels like those of the Juan Fernández Islands. Another three days and we awoke to find ourselves approaching San Felix, having already passed the much higher island of San Ambrosio.

Eleven miles apart, they both are rocky and treeless, at first apparently devoid of vegetation. A third island, Gonzales, lies close to San Felix, as though they might be remnants of some old gigantic crater, now chewed apart by the relentless ocean. Flocks of sooty terns flew out to meet us, and a few white boobies with black wing-quills. The principal reason



THE ROUTE OF THE CROCKER PACIFIC EXPEDITION

The "Zaca" which carried the party almost 14,000 miles through the Pacific, is a two-masted schooner, 118 feet over all. The present article describes the last leg of the journey, from the Juan Fernández Islands north to Panama for our visit was to make a list of the resident birds for Doctor Murphy. He had seen a poor photograph of a booby taken at San Felix, where they were said to have nested in great numbers before the Chilean earthquake of 1922. The only species of booby we saw here was this masked booby, *Sula dactylatra,* so the puzzle was solved.

The western end of San Felix is formed by a high yellowish hill of soft tufa. On this elevation we at last made out scattered low bushes covered with gray-green foliage. To the northwest of the anchorage a gray cathedral-like rock rose from the sea. The only landing-place on the island was a ledge beside a deep cave, where an old rope dangled down the low cliff. The rope had apparently been left by the training-ship "Baquedano," for its name was painted on the rock.

Ashore on San Felix

Our second officer climbed up the old rope and attached a safer one for me. With a sailor-companion I was then able to wander all over the dusty top of the island. Traces of a few old booby nests were seen, but only one pair still attended patiently to their egg, which was hopelessly addled. They may have been waiting months for it to hatch. The sooty terns and gadfly petrels (*Pterodroma cookii*) had practically finished nesting; all but a few of their young were on the wing. Gray noddies alighted confidingly on the rocks about us, but had no nests.

On the lower section of the island, built of successive flows of brown-black lava, there were low round bushes of purplish sea-blite, and a very few examples of a grass and a mallow. Four species of plants were all I could find. The only conspicuous insects were large flies which swarmed upon us, especially in the spots where colonies of terns had nested.

In the afternoon the "Zaca" took us back to San Ambrosio. Here the bare forbidding cliffs, hundreds of feet high, made me doubt that anyone had ever climbed them. The very top of the island, rising to 1470 feet, was well covered with greenish bushes, over which hundreds of large petrels *(Pterodroma neglecta)* could be seen circling. They evidently had a well protected breeding community there.

As night fell white-bellied storm-petrels (*Fregetta grallaria*) made their appearance around the yacht, as birds which had been feeding offshore came in to replace their mates on the nests.

I have since learned to my surprise that in 1869 Simpson reached the summit of San Ambrosio and brought down in his hat specimens of its plants. Seven of them do not occur even on San Felix.

To the guano islands

Our next port was Pisco in Peru, just inside the Chincha Islands, the best known of all the guano islands. Here millions of seabirds unwittingly add to the revenues of the Peruvian Government. We were to collect materials to show the guanay cormorants. *(Phalacrocorax bougainvillii),* Peruvian boobies *(Sula variegata),* and brown pelicans *(Pelecanus thagus),* which nest on these rainless islands in incredible numbers. In prehistoric times their excreta raised the elevation of one of the Chinchas by 180 feet.

During the nineteenth century this accumulation of fertilizer was dug down and exported even to the opposite side of the earth, its exploitation sometimes accompanied by the utmost brutality toward the workers. Moreover, the birds themselves were dangerously depleted in number before the government of Peru awoke to the wisdom of protecting the birds to insure a permanent supply of guano.

Now, before landing on the Chinchas, we would need a special government permit. Thanks to my colleague, Doctor Murphy, and his good friend, Señor Ballén, director of the government guano administration, this permit was awaiting us at Pisco. So we recrossed the bay, plowing through a great flock of "guanayes" busy with their fishing, and anchored between the North and the Central Island.

We were greeted by the guardians of the islands, whose chief inspected our official papers; and they began by showing us over the Central and South Islands. The North Island was black with a new brood of full-fledged "guanayes" or cormorants, and from morning till night their parents streamed out in long lines toward the fishing grounds.

Around the cliffs were the colonies of Peruvian boobies or "piqueros," and on top of these declivities sat rows of huge brown pelicans, at once sedate and foolish-looking. On the wing they would become majestic. Low down on the rocks flocks of Inca terns with white ear-rings of feathers took their repose, while there, too, and especially near caves, one might see small parties of Humboldt penguins.

The Central Island had only a small colony of '"guanayes" still sitting on their nests, and the same was true of the South Island, which had recently undergone a "harvest" of its guano. No blade of grass or twig of a bush could be found on any of the three islands. But cormorants must have nests, so these utilized the cast-off wing and tail quills of their own kind, building a soft if filthy cradle in which to lay their eggs. Most of the nests held newly hatched young, ten times homelier than any ugly duckling, with small black heads and snaky wrinkled necks.

Planning a bird group

Jaques, with practiced eye and previous experience of the Peruvian islands, quickly chose the south end of the South Island for his background, with the Ballesta Islands and San Gallan in the distance. It was my sorry duty to gather the specimens to be placed in the foreground of the group. Nothing but birds painted in the background can ever give an idea of the numbers of sea-birds about these islands.

Down below us on the stony beaches dozed hulking bull sea-lions, with their smaller mates and progeny. The protectors of the birds, I am sorry to say, frequently shot the sea-lions; yet the latter seemed in no danger of extermination. In three days we went over the islands thoroughly, taking photographs, collecting the number of old nests needed, and what few other accessories could be had. Nearly all my birds were obtained over the water. Ashore the air was frequently nauseating, and even as the "Zaca" left to sail northward toward Callao it passed to leeward through a fog of white dust and down-feathers.

The following morning, as we rounded the mountainous island of San Lorenzo to enter the harbor of Callao, looking in vain for a possible condor, the guano birds were all about us. Our stay of four days, with frequent visits to Lima, was largely devoted to sightseeing. An Exposition of the Fourth Centennial of the Founding of Lima was in progress, where ornithological exhibits from the University Museum were on view, including a habitat group of guano-producers.

Right after leaving Callao we paid our farewell visit to a pair of small but remarkable bird-islands. Some thirty-five miles offshore are the "Hormigas de Afuera," the "offshore ants," low bits of rock where guano cannot be gathered because of the dangerous surf. Their tops would be pure white were it not for the army of "piqueros" nesting on them, leaving room only for a herd of fifty sea-lions on the larger one and ten more on its smaller neighbor. There were also, to be sure, a small group of twenty "guanayes," and some Inca terns on rocks too steep for the larger birds. Strings of "piqueros" kept flying in until we were watching them cross the red disc of the setting sun.

On all sides the breakers roared, sending their spray higher than the dark rocky wall of the islets that rose only twenty-five feet above sea-level. Any attempt to land would have been foolhardy, so we were unable to learn anything of the nesting of the small storm-petrels which appeared after sunset. Rollo Beck had had the same experience here.

Isles of the tortoises

That evening the "Zaca" set out for the Galápagos Islands, about a thousand miles to the northwest, where the ocean water is some ten degrees warmer than that of the Peruvian coast. Consequently the sea-bird fauna is almost totally different. Now it was early March in 1935, and I was to revisit the islands where I had gone five years before as a guest of Vincent Astor on his yacht "Nourmahal."

Some of my friends, even after visiting the Galápagos, describe them as cool and comfortable, despite their equatorial location. I am a violent dissenter, in so far as the months of March and April are concerned, when my visits occurred. Other seasons may be different. Shortly after the turn of the year the rains arrive in the archipelago, the air warms up and becomes sticky. A cooling breeze may blow on the beach or over the mountains, but nowhere have I ever been more freely bathed in perspiration than while finding a way amid the cactus thickets of the Galápagos, just back from the shore.

Yet these islands are superlatively attractive to a naturalist, more so than the beautiful ones we had visited in Polynesia. Life is so much more abundant on them. Giant tortoises are still to be found, land-iguanas with the bite of a steel trap, other iguanas diving for seaweed in the ocean, hawks without fear of man, mockingbirds and flycatchers bold and inquisitive, pretty doves most peaceful of all, and the smallest barn owls in the world. Among mammals there are sea-lions and a few surviving fur-seals, but only a couple of species of native rats.

The avifauna of the Galápagos, first studied by Charles Darwin in 1835, is now exceedingly well known. It offers wonderful examples of the efficacy of isolation in the origin of species and subspecies—much more complex, probably, than Darwin suspected. In the celebrated case of the finches (*Geospiza* and allies), while a few species are restricted to a single island, the majority are found on several islands, and may or may not be divisible into local races.

Indefatigable Island, for example, is inhabited by eleven species of these small birds. It would seem that species first developed through isolation and later came together without interbreeding. One may claim that every step in the development of a species, or even a genus, can be followed.

Our party could not undertake an extended survey. The task was to select a spot well stocked with land-birds, with suitable scenic properties, and to collect all that would be needed in the Whitney Hall.

Approaching from the southeast, passing Hood Island, to my regret, at night, we sighted first the southern end of Albermarle and continued around the western side. The first afternoon a landing was made on a rather barren lava-field just south of Elizabeth Bay, where a few small Galápagos penguins were the birds of greatest interest. Consorting with tropical brown pelicans, yellow warblers, and an egret, these penguins were a paradox in an order of birds so often associated with bleak coasts and Antarctic ice.

Aims in the Galápagos

Our next stop was in Tagus Cove, also on Albermarle Island, its steep rocky wall adorned with forty-seven names of yachts and tuna-fishermen in white paint. To "Zaca, 1932" was added "1935." Below these mementos sat groups of marine iguanas, four large brown cormorants (*Nannopterum harrisi*) with wings too small for flight, pelicans, blue-footed boobies, turnstones, and wandering tattlers. No penguins were visible; I fear that they had all been exported to zoölogical gardens. A brief excursion convinced us that neither the thin bushy vegetation nor its resident land-birds were adequate for our group.

More flightless cormorants and penguins were seen on the north shore of Narborough Island before we circled the north end of Albermarle to double back toward Indefatigable. At James Island, on the way, we stepped ashore in a particularly well wooded bay; but eventually we chose a site for our group at Conway Bay on the northwest side of Indefatigable Island.

Plants and birds

The rough lava hillocks here bore low woods of *Bursera* and other trees, with large cacti of two kinds. Finches were numerous and varied, a very conspicuous black species clambering about the *Opuntia* cacti, pecking at flowers or fruit. Other kinds ate berries and seeds, or devoured the green caterpillars so abundant at this season. Leaves were growing rapidly on the trees, showers were not infrequent.

The view northward included so many islands as to give a vivid impression of the Galápagos as an archipelago. Frigate-birds, brown pelicans, blue-footed boobies, and lava gulls were passing continually. Mockingbirds came to inspect Jaques as he painted the scene in oil under a canvas shelter. Blue-black martins came flying over from Eden Island.

Nearly two weeks were required to complete our work. Fresh bird-skins were desirable, as well as many sections of woody plants and cacti to be reconstructed in the foreground. Some of the crew aided us ashore, others ran the small boats to and from the yacht, and under Mr. Crocker's supervision every detail was organized for comfort and efficiency.

My rat traps here caught nothing except introduced black rats. One evening I found the sailors collecting the tropical clawless lobsters in the rocky shallows. About fifty of them were boiled in sea-water in a large iron barrel, and never have I tasted better lobster.

But the cloud of mosquitoes around the fire was almost unbearable.

At Conway Bay our bird-group work was ended. We still had time to visit Academy Bay on the south side of the island, where an unsuccessful attempt had been made to found a Norwegian fishing station. The governor of the archipelago was there on a visit, and among the several European residents were Stampa and Wold, who had assisted us during the "Nourmahal's" visit in 1930. In that year there were but three men living on Indefatigable.

An old friend

The third was Elias Sanchez, an Ecuadorian, whom we had discovered hiding behind the banana plants on a farm in the interior. He was watching us, and very suspiciously, until Kermit Roosevelt addressed him in Spanish. Now in 1935, along the trail leading inland, I again came face to face with Sanchez, beaming with joy at our meeting.

The population of Academy Bay has now increased to about twenty-three, including Mr. and Mrs. Rader, Messrs. Finsen and Worm-Müller, Scandinavians, and Mr. and Mrs. Küppler, Germans by birth.

The place used to be celebrated for its hawks, forty or fifty of which could always be seen sitting around on trees and buildings. They were so tame that not only could they be snared with a loop on a pole, but actually induced to perch on a rake and lifted a few feet down before they took wing to regain their perch.

We know that the principal food of this bird (*Buteo galapagoensis*) is huge centipedes; but because of fear that it might attack chicks, it has been slaughtered until now one sees but four or five in a day. The doves (*Nesopelia galapagoensis*) have disappeared for another reason; they were too palatable.

It must be added, however, that the Ecuadorian Government has recently set aside as wild-life reserves a great many of the uninhabited islands. The strict regulations against destruction of the native fauna there should prevent extermination of any of the remarkable species.

Our last morning in the archipelago was spent at Darwin Bay on Tower Island, where a populous colony of frigate-birds breeds unmolested year after year. They are all of one species, *Fregata minor,* whereas on Indefatigable Island only *Fregata magnificens* was commonly seen. When a ship enters Darwin Bay a flock of these great soaring birds gathers above it, but without one adult male among them. The majority are females, with dark heads and white breasts. A few immature birds can be recognized by their white heads.

Even from the anchorage some of the males can be seen sitting on their nests with red throat-sacs inflated. Others are in the air, but they avoid the ship. The stick nests are mostly on low bushes not far back of the shore; and in two different years I have seen the colony very active, with eggs but no young nestlings, in late March and April. How long their breeding season lasts I cannot say, but this would seem to be its commencement. A few masked boobies make their homes on the ground, while red-footed boobies build most of their nests a little higher in trees. Beautiful forked-tailed gulls *(Creagrus furcatus)* incubate their eggs or tend their chicks on rocks close to the shore. Gray lava gulls *(Larus fuliginosus)* gather on the beach, but seem not to nest here.

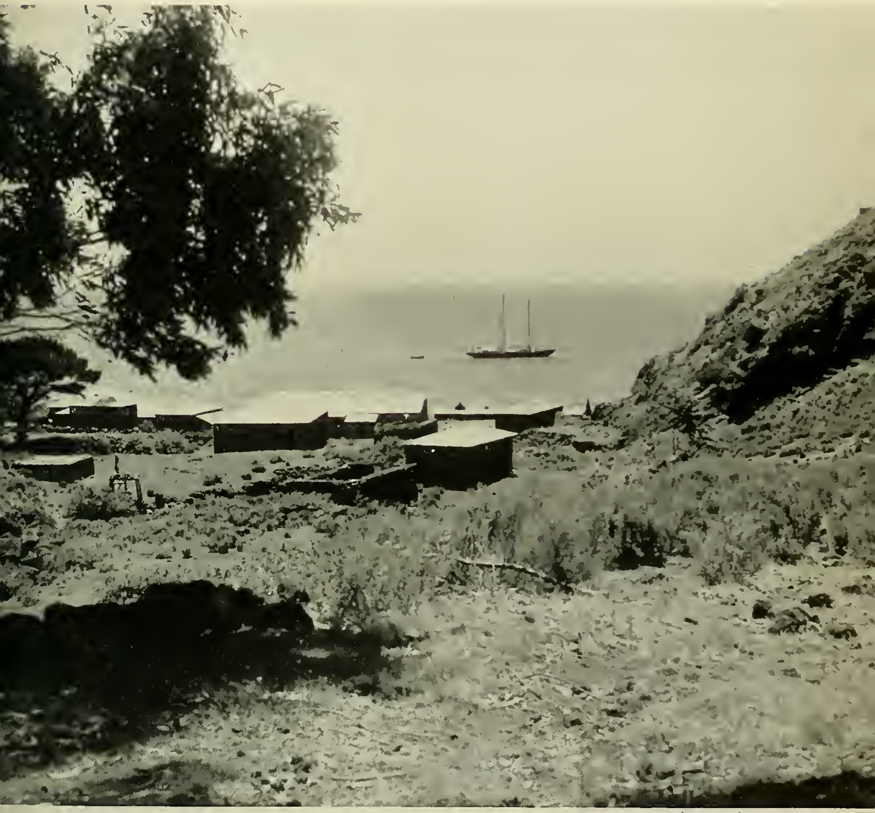
The sun beat down with an ardor that was fully equatorial. We had drunk all the water in our canteens. Yet it was not without regret that I quit this torrid shore for the cool comfort of the "Zaca," wondering whether I should ever pay it a third visit.

Farewell to the Pacific

Five and a half days later we were off the Pearl Islands in the Gulf of Panama; and early the next morning, the first of April, 1935, we docked at Balboa. Old friends waited on the dock: Mrs. Jaques, Doctor Chapman, James Zetek, and Doctor Guillermo Patterson. Patterson and I were school-mates; Doctor Chapman has watched over me almost since my school days. Largely to Zetek we owe the Barro Colorado biological station, where Doctor Chapman soon took me.

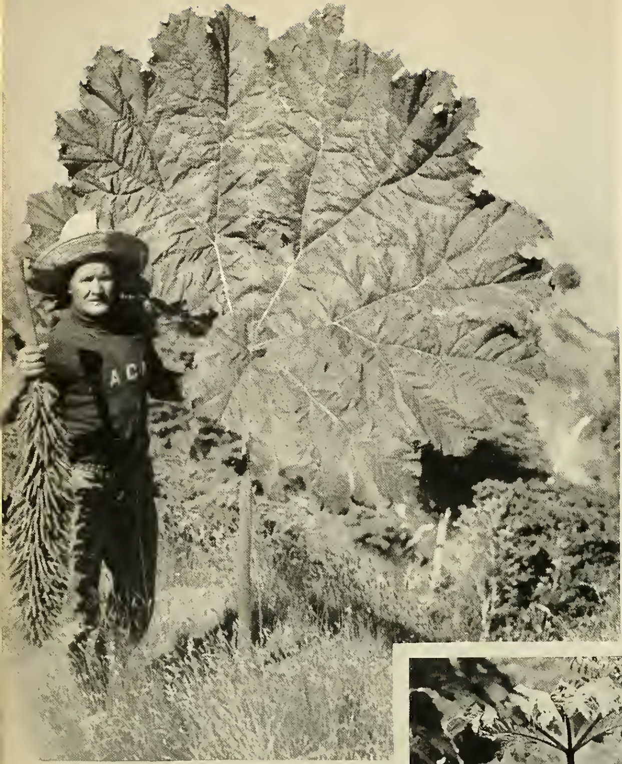
Since I had been signed on as Purser of the "Zaca" I received my Certificate of Discharge at Balboa. The notations concerning my ability and my seamanship I consider altogether too flattering. For six and a half months I had been privileged to watch the ocean, the islands, and the birds. For that I give thanks to Mr. Crocker and the Museum.

Islands West of South America

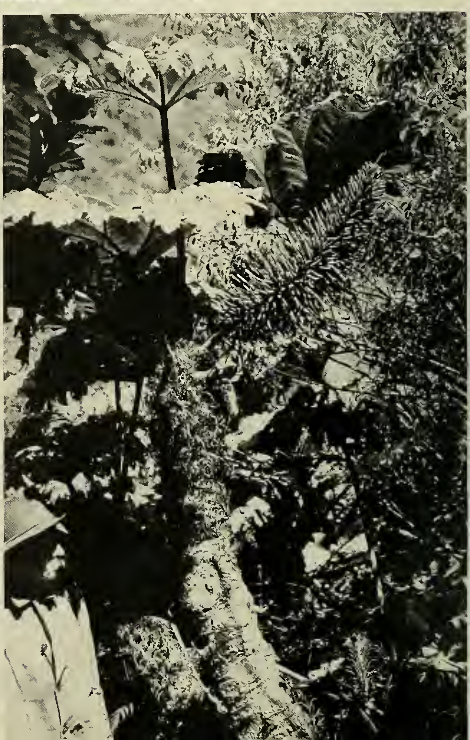


Toshio Asaeda

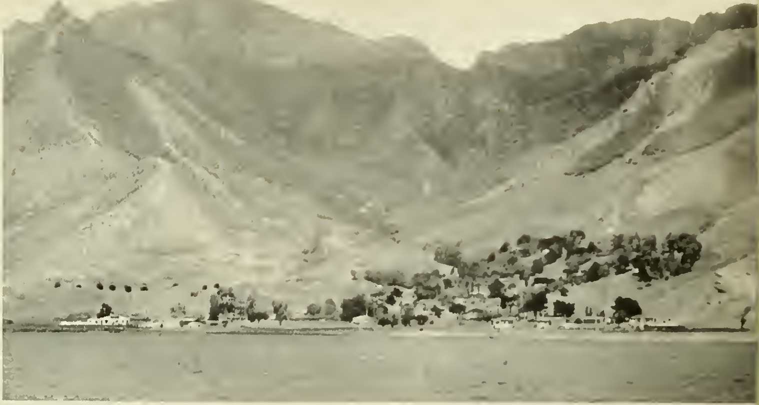
Except for a few eucalypts and pines there was no shade about the deserted penal colony on Mas Afuera, the outermost island of the Juan Fernández group. Located at the mouth of a great gorge, it needed no prison wall, many miles of ocean serving far more effectually



The largest leaf, save those of palms, that I have ever seen. Jack Ratikan, a sailor born north of the Arctic Circle, holds up a Gunnera *leaf and flower-spike*



A Gunnera *plant in the woods on Mas Atierra. Mr. Bock, who stands by its stout trunk, is an enthusiastic collector of plants, and volunteered to guide us on our short visit to this island*



The main village on Mas Atierra, named after St. John the Baptist. The notch in the ridge behind, some 1800 feet above the sea is Selkirk's Lookout, where he could watch for a sail on opposite sides of the island. The middle slopes of the mountains are well wooded, the shore decidedly arid

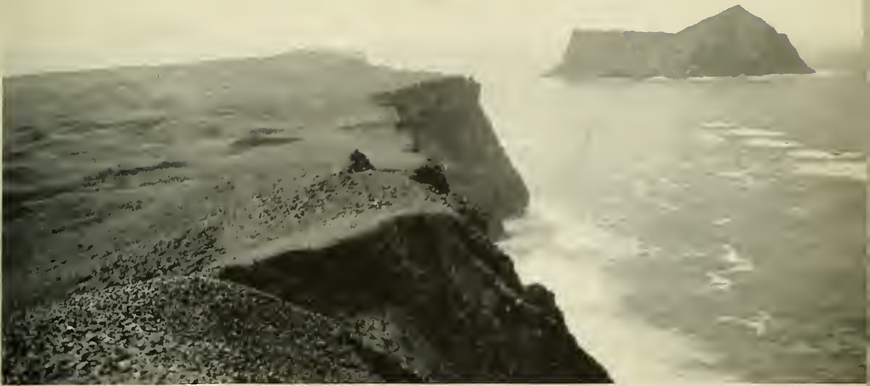
Toshio Asaeda

(Above) View over the harbor of Valparaiso, with the "Zaca" moored beside the "Alva" and Chilean naval vessels (Right) a Close-up of the venerable training ship "Baquedano"

(Above) San Ambrosio Island from the west. Its forbidding cliffs make it a fortress for nesting petrels, and on its summit grow a dozen or more species of plants that illustrate the effect of long isolation from the continent

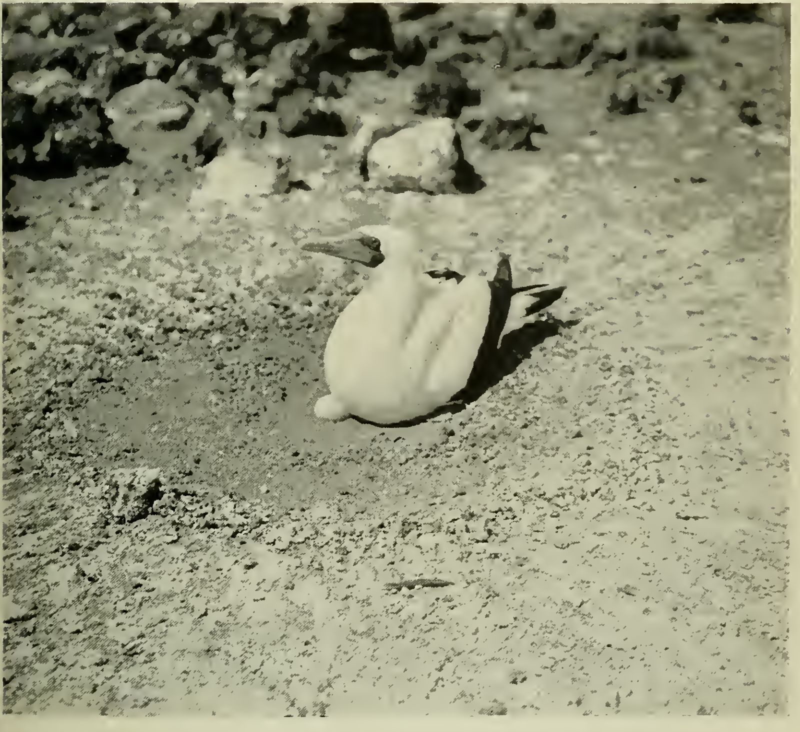
(Below) The only place to land on San Felix, at the left of a deep cave worn by the sea. Successive flows of lava are indicated by the bands in the cliff, which show that originally the island was very much larger

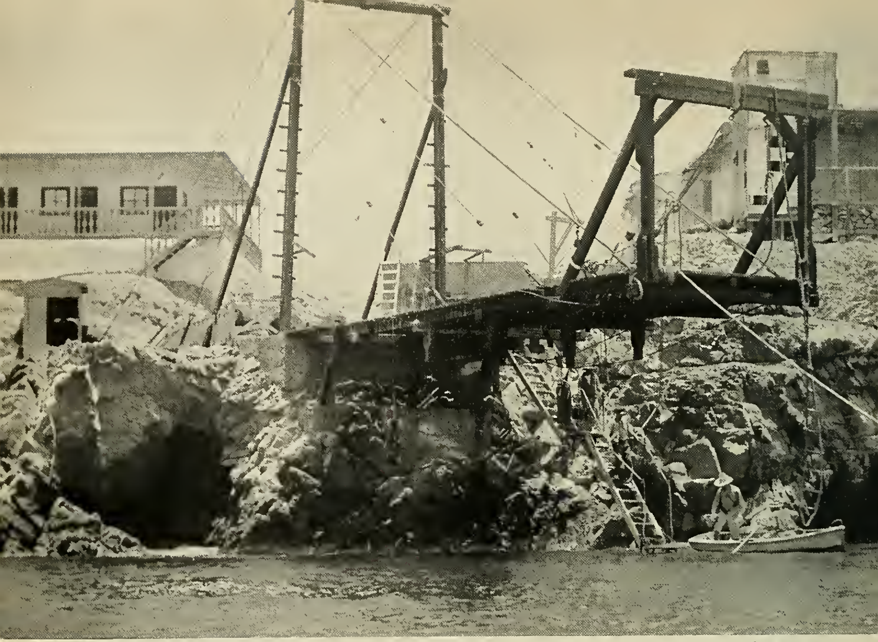
(Photo by Toshio Asaeda)



(Above) View along the barren plateau of San Felix. From these high black cliffs the ground slopes gently in the opposite direction toward the landing place. Gonzales Island in the right background

(Below) A masked booby of San Felix on her nest. Restricted to the warmer oceans, this species is found around the world. The gannets of the colder oceans are near relatives of boobies

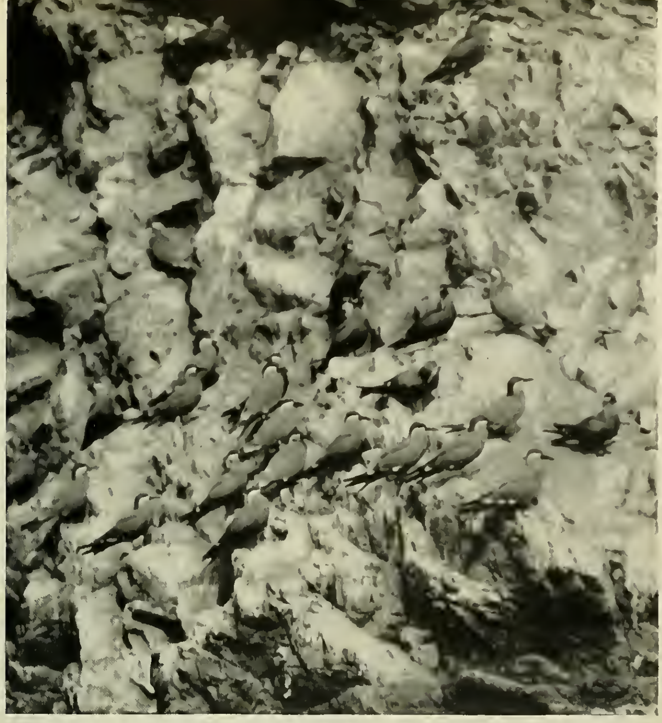




Toshio Asaeda

(Above) The Chincha Islands are well equipped for the loading of guano into ships. Each island has its piers, and here and there are quarters for the guardians and the workers

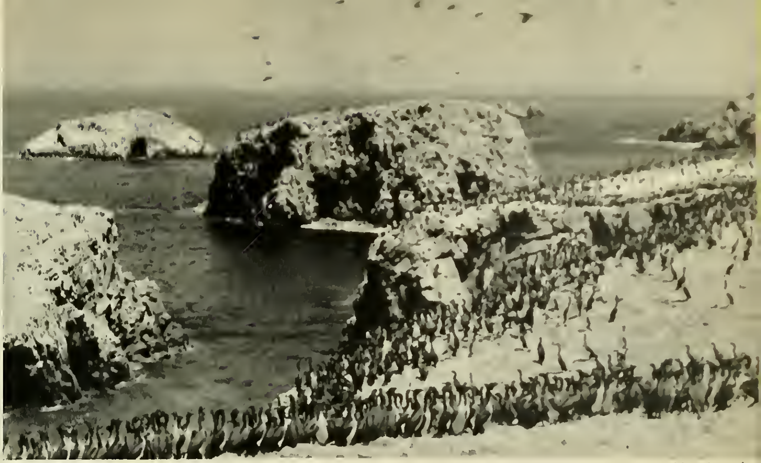
(Below) Those "very strange birds," the pelicans, live on the tops of many cliffs, from which they can readily take wing. The passing of our motor boat, however, rarely disturbed them



(Above) Inca terns feed in flocks low over the water, and rest on steep rocks along shore. At first glance so strikingly different from others of their family, they are perhaps most closely related to the plain-colored noddies

(Below) Two Peruvian bird-protectors on the Chincha Islands, with some of their charges, guanay cormorants, on nests near by. The hollows in the white surface of the island mark the location of myriads of old nests

(Above) An old male sea-lion rears his head from the water, in concern or perhaps out of curiosity after his companions have deserted the shore at our approach. Ungainly they may be on land, but once in the water these sea-going carnivores are marvels of grace and speed



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(Above) This picture may be suggestive of a penguin island, but really shows a colony of strong-flying cormorants. Their numbers were augmented by a new brood of full-grown young

(Below) The genesis of a Chincha Island background. Mr. Jaques makes his initial sketch of the rocky headlands and the distant islands from the site of the future bird-group

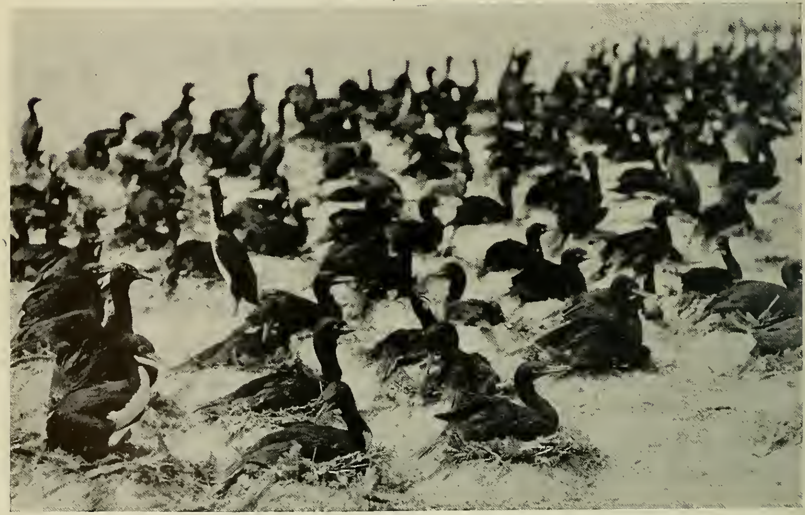
Toshio Asaeda

Mr. Crocker examines the mail at the "P.O. Tagus Cove," on Albemarle Island. The box was first set up in this uninhabited bay by Mr. W. A. Robinson so he could receive mail from home by any fishing boat or yacht

(Continued opposite)

(Below) A peaceful section in a colony of the guanay cormorant. According to Doctor Murphy this is "the most valuable bird in the world" as appraised by the total rent it pays for its ill-smelling tenements

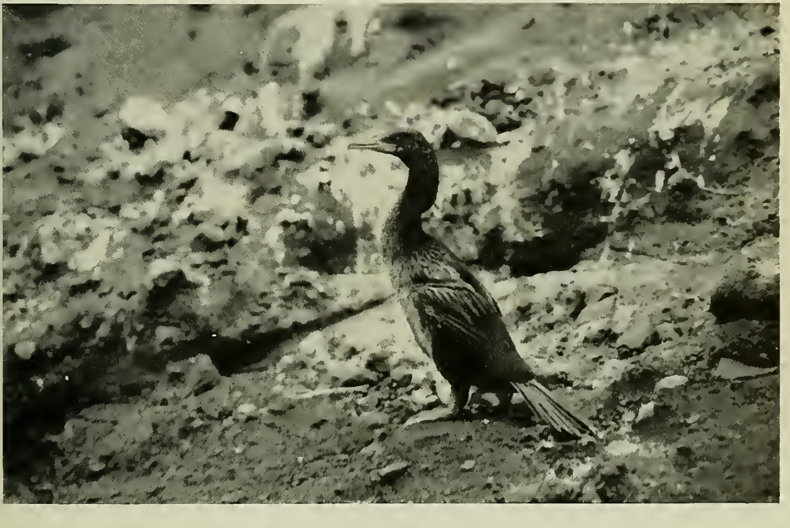
(Photo by Toshio Asaeda)

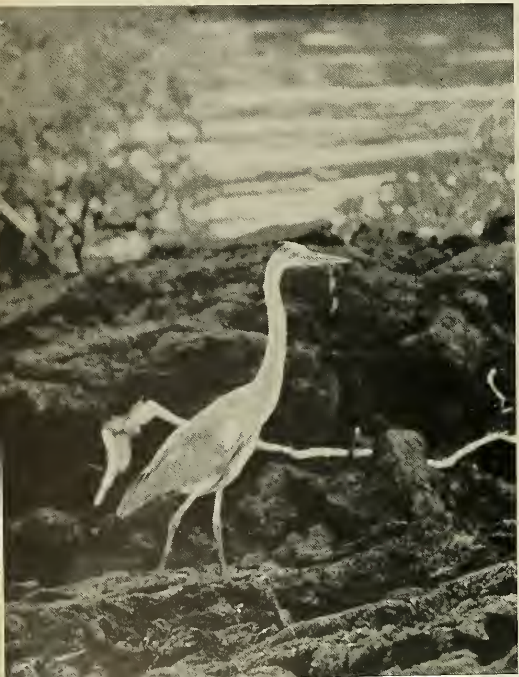


that came there from Panama, even though he might be away on some short cruise. Here also Mr. Robinson would have died of appendicitis if he had not been able to send a radio from a California tuna-boat

(Photo by Toshio Asaeda)

One of the prominent residents of Tagus Cove, a flightless cormorant. These birds, unknown before 1898, are among those most in need of protection, as they are found only in a small western section of the Galápagos





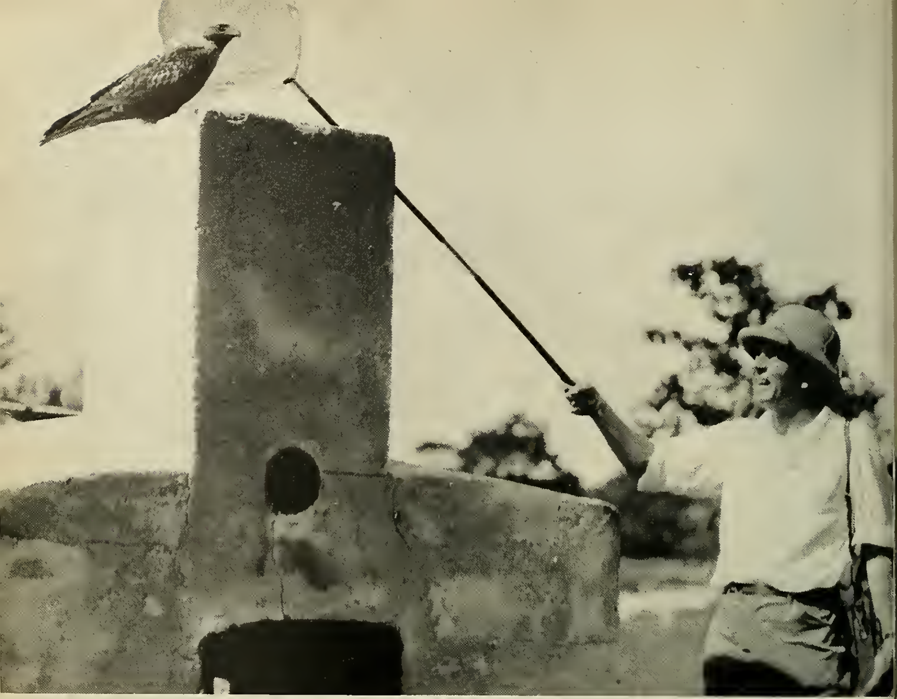
(Above) At Conway Bay on Indefatigable Island Jaques was making a beautiful reproduction in oil of the broad expanse of beach, sea, and islands to be shown in his background. The burning sun made an awning necessary, while the fresh breeze rendered guy-ropes advisable

(Photos all by Toshio Asaeda)

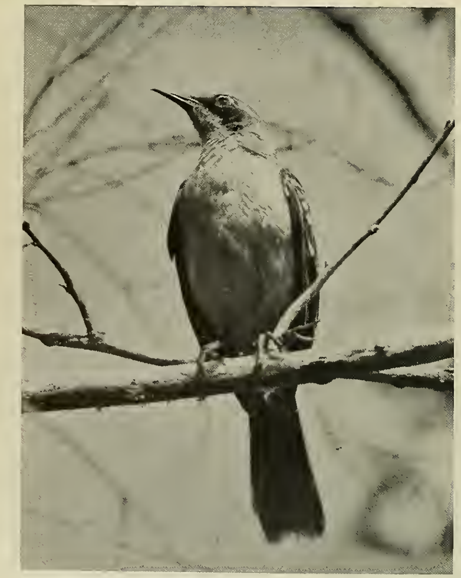
(Left) A great blue heron on the rough lava shore of Conway Bay. It differs very slightly from the North American race of the same species, whereas certain of the other water birds are more markedly divergent from those of the mainland

(Above) One side of Conway Bay, with Eden Island a little off shore. "Eden" it is, perhaps, for marine iguanas and birds. This view is only the left end of the background as planned; to the right many other islands were visible

(Below) A Galápagos green heron that appears to have seen something. When in repose it would draw in its neck so as to appear nearly half this size. This bird is much sootier in color than its relatives on the American mainland



(Above) Mr. Clarence Hay, in 1930, demonstrating how little a Galápagos hawk fears to be taken for a butterfly. Tameness is an outstanding characteristic of many Galápagos birds

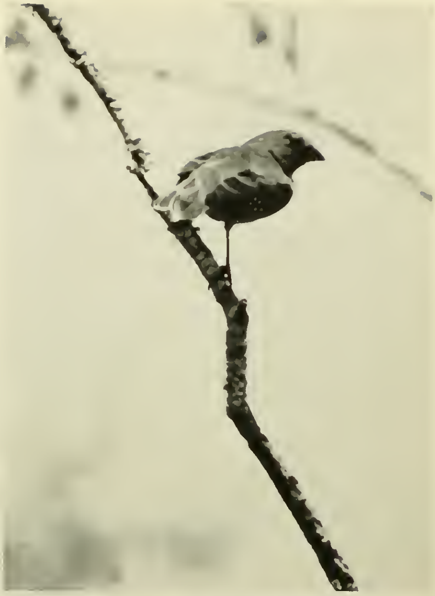


(Left) Galápagos mockingbirds are sturdy, venturesome, and inquisitive members of their clan, also less musical than many. There are marked differences between the several forms in various sections of the archipelago, this one being native to Indefatigable

(Photo by Toshio Asaeda)

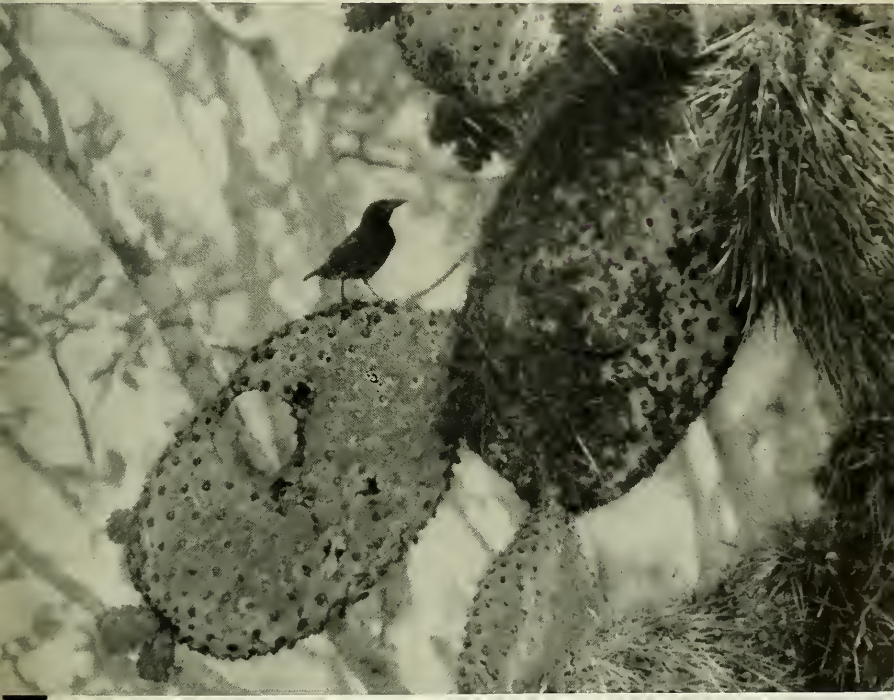
(Right) One of the brownish Galápagos finches, many of them the females or young of birds that become black in the adult male. In other species even the male may always be brown. To the biologist these are birds of special historical and evolutionary interest

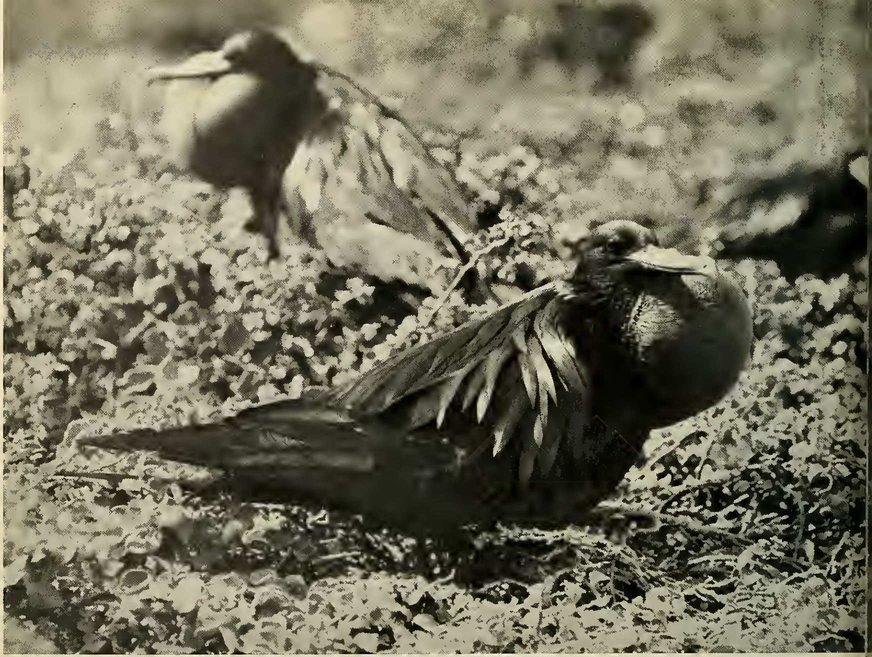
(Photo by Toshio Asaeda)



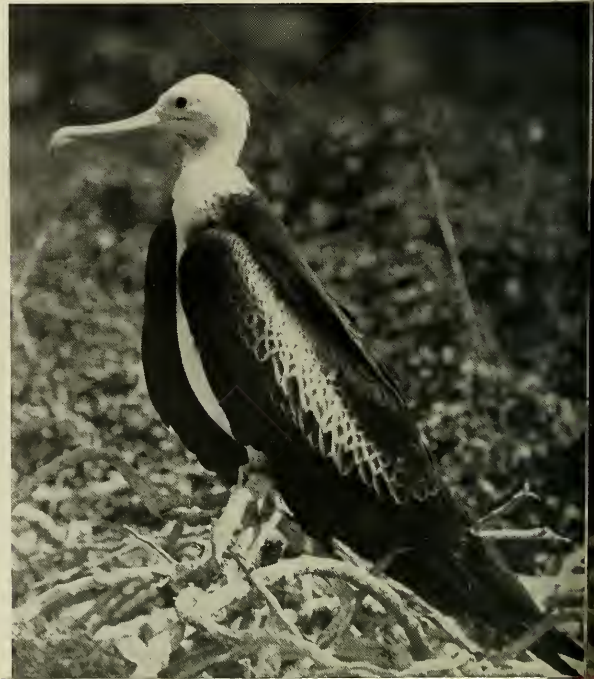
(Below) A black cactus-finch perched on its favorite food-plant, the Opuntia *cactus. It may be responsible for the sizeable hole below. Its nest is placed amid the spiny pads of the same cactus*

(Photo by Toshio Asaeda)



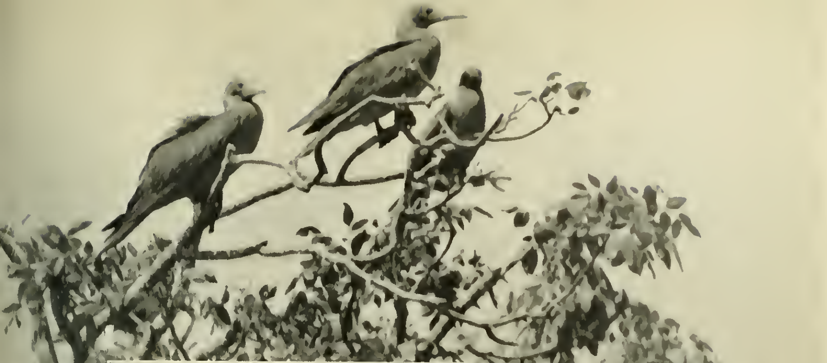


(Above) Looking proud as a rooster, with gleaming hackles on his back, the male frigate-bird seems also to imitate the pouter pigeon



(Right) A young frigate-bird fully capable of flight, still frequenting the old homestead on Tower Island. When it has stolen enough fish from other birds it will mate and start housekeeping too

(Photo by Toshio Asaeda)



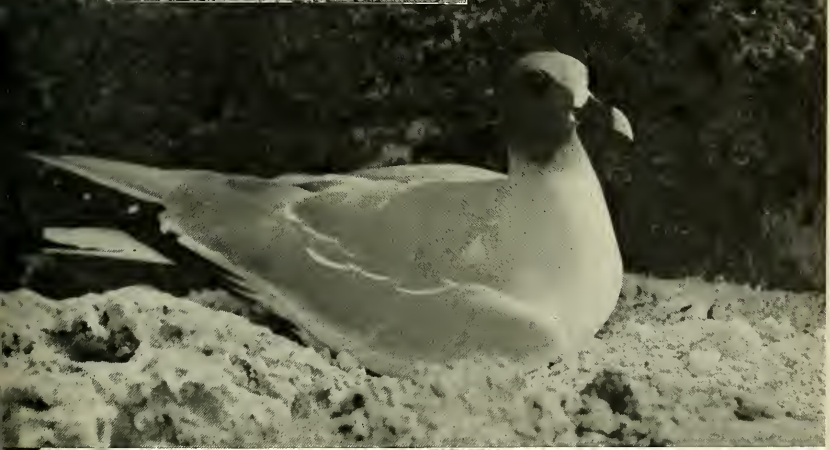
(Above) The majority of red-footed boobies in the Galápagos remain in a nondescript brown plumage, instead of becoming almost wholly white. They are very fond of perching in trees

(Photo by Toshio Asaeda)

Mr. Toshio Asaeda, photographer, tests the wood of an Opuntia *tree*

Except in its large brown eye, encircled by red skin, the fork-tailed gull when incubating shows little distrust of a human visitor

(Photo by Toshio Asaeda)



Perpetual Ice Under Lava

A natural "ice-box" in New Mexico, where the motorist can find welcome relief from the summer sun and an interesting scientific puzzle to solve

By JOHN STEWART MACCLARY

A LAVA bed whose surface is unpleasantly warm to the touch does not seem a likely setting for a deposit of perpetual ice. Yet in just such a locality, where the brazen New Mexican sun beats down upon a surface which once was molten stone, a deposit of perpetual ice does exist.

Signboards lead the traveler to a volcanic sink, an abrupt depression of an estimated depth of seventy-five feet. This was produced when a natural tunnel in the lava bed caved in. The tunnel was caused by the flowing away of molten lava from the lower part of the bed after the upper surface had cooled and hardened.

The floor of the sink is covered by jagged chunks of grayish black basalt which once formed a roof above the cavity. The accumulated warmth of the air in the depression strikes one almost like the blast from a furnace. One wonders how ice could possibly withstand a temperature such as this.

A hoax?

A skeptical mind prompts the cynical thought: "Just another 'gag' to snare the credulous tourist!" But there is no admission charge, there is no tip-seeking guide, and another sign insists that the Perpetual Ice Cave can be seen at the end of the trail which leads down into and around the volcanic sink. Irregular chunks of fallen stone block what seems to be a cavern in the wall of the sink. As the perspiring visitor approaches this rubble, the air becomes noticeably cooler. Perhaps, after all, the cave of perpetual ice is not a myth.

By this time a feeling of eager expectancy has seized the visitor. He climbs the heap of fallen stone that obstructs the mouth of the cavern. At the summit of the disorderly pile he gazes down into the depths whence comes the current of cool air.

The sight which greets his eyes is well worth the effort he has spent. Imagine a bank of solid ice, mild aquamarine in color, from 12 to 14 feet in height and some 50 feet in width, calmly resting in a tunnel of what once was molten stone—the hottest manifestation of the earth's internal heat!

Feeling is believing

The visitor touches the ice with an experimental finger Yes, it *is* ice—not some illusory mineral crystal. Gone is all skepticism. If the bank of ice can withstand the heat of this August day it must deserve the qualification "perpetual."

The ice is horizontally banded by strange dark lines of stratification. The nearly vertical face of the mass is gracefully curved from left to right. There is very little water from melted ice at the base of the deposit, and what there is registers 32 degrees Fahrenheit. The temperature of the air in the volcanic sink just outside the mouth of the cave is that of a cloudless August noon in the desert of western New Mexico.

The beholder is naturally perplexed as to how the ice was formed and why it does not melt away.

Its presence so near the hot surface of the ground depends primarily upon the fact that lava is among Nature's most efficient temperature insulators. The lava contains an infinite number of minute pores and cavities, and the dead air in them hinders the transmission of heat through the stone from the sun. Once the bulk of a lava deposit has become thoroughly chilled to its depths, heat from the sun cannot penetrate the frigid mass. The cold which produces the ice probably comes from far below the surface. The ice is formed at a point where moisture filtering downward from the surface is met by frigid air from the depths of the insulated volcanic tunnel.

The only warmth which reaches the ice deposit comes from infrequent swirling gusts of air that has been heated in the volcanic sink beyond the obstructing rubble at the mouth of the cavern. The effect of such eddies of warm air is seen in the curving outline of the face of the ice deposit.

The bluish-green tint of the ice is probably produced by pollen wafted onto the ice surface at times when the mass was slowly forming, from pines that grow on the lava outside. The darker bands of stratification were formed by layers of dust similarly deposited. From a distance, or from a photograph, it might be supposed that these bands could be used as reference marks for tracing the age of the deposit as are growth rings in a tree. Actually, the dust bands are not distinct when seen at close range.

Age

It has been said by competent geologists that the lava bed in which this ice deposit is found is of comparatively recent formation. The geologist's interpretation of the term "recent," however, differs from the historian's. On the surface of the lava flow are magnificent yellow pine trees, having trunks more than three feet in diameter. The yellow pine grows slowly in a land where moisture is scant; moreover a fresh bed of lava would not at once offer soil for vegetation. Weathering and the accumulation of dust for a seed bed must have first occurred.

Another bit of evidence of great age lies in the fact that no incident of volcanic eruption has been found in the historical anecdotes of the Indian tribes of the region. And archæologists in the Southwest present evidence that the region has been continuously inhabited for more than a thousand years.

Everything considered, it seems probable that the ice deposit has survived the torrid summers of many centuries in a land whose lack of moisture is almost proverbial.

Deposits of ice in lava beds are not particularly rare. Their occurrence, however, is seldom noted so far south as central New Mexico, (central, that is, from North to South; the deposit is not far from the Western limit of the state). On the map of the United States this spot is almost at the intersection of the parallel 35 degrees north with the meridian 108 degrees west. The elevation is a little more than 7000 feet above sea level.

How to get there

In most known ice beds which occur in lava caves the deposits melt during warm weather. Several ice deposits of continuous existence have been found near the Perpetual Ice Cave, but they are not accessible without the use of horses and resident guides. The Perpetual Ice Cave, may be visited by motorists, by following a secondary road leading southwestward from the town of Grant, New Mexico, on transcontinental highway U. S. 66. The detour moreover takes the traveler to a number of other interesting sites, including the old Spanish town of San Rafael, El Morro National Monument, the old Mormon village of Ramah, and the Indian pueblo of Zuni.

Not far from the mouth of the Perpetual Ice Cave are numerous remains of prehistoric habitations. The ruins consist of low circular walls of lava blocks, presumably primitive foundations. The identity of the builders and inhabitants never has been determined by investigators. It seems probable that proximity to an unfailing source of good drinking water—the ice cave—was justification for settling or camping in a spot where agriculture was not practical.

In this civilized age when "air conditioning" and "automatic refrigeration" have become common terms to most of us, the Perpetual Ice Cave is probably not so mysterious as it was to the primitive Indians who saw it before us.

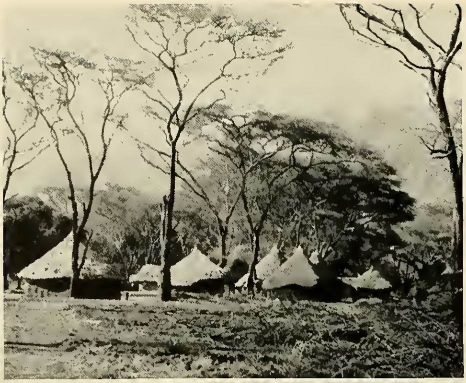
Perpetual Ice Under Lava

(Left) A bank of solid ice in a tunnel of what once was molten stone: a natural "ice-box" in New Mexico

(Right) The entrance to the chamber containing the ice. The air here on a summer's day is suffocatingly hot

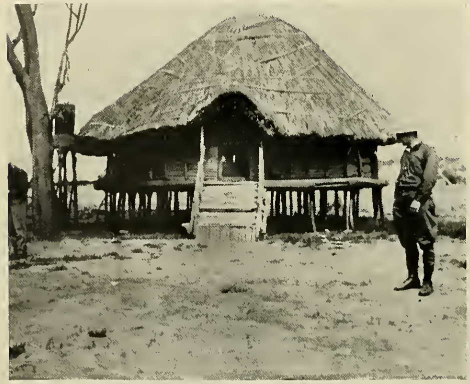
The wall of ice is mild aquamarine in color, from 12 to 14 feet in height, and some 50 feet in width

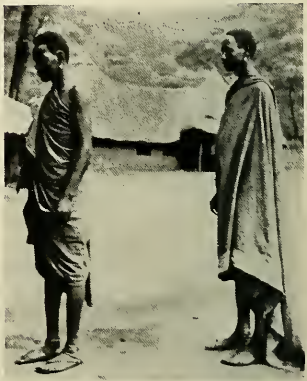
All photos from "Frashers," Pomona, California



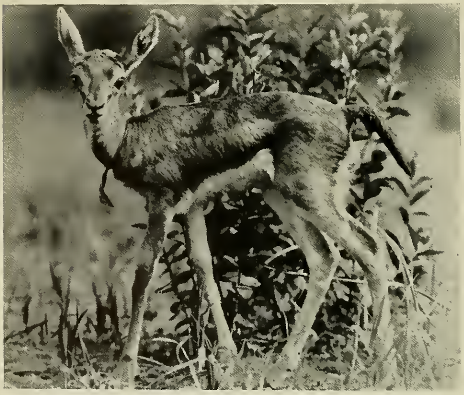
(Left) Maji Moto Camp in Tanganyika Territory at the foot of the Great Rift Wall: the base from which the expedition studied the animals of Africa in the interests of medical science

(Next below) The hut that was used as a laboratory. Native huts rather than tents were used to shelter the expedition. The one shown in this photograph boasted running water supplied by the tank at the left





(Above) Mbulu natives. This tribe lived some four hours' march from camp, on the Rift plateau



(Left) A young female Thomson's gazelle captured on the plain adjacent to Lake Manyara. This animal became very friendly and was a great pet of the expedition

A Safari with a New Objective

An African expedition to search for physiological explanations of temperamental differences in animals and new knowledge on human glandular disorders

By GEORGE CRILE
and
DANIEL P. QUIRING

AN expedition to Africa sponsored by the Cleveland Clinic Foundation and the Cleveland Museum of Natural History was organized in the winter and spring of 1935, the members of the expedition leaving in the fall of that year.

Two members of the group, Dr. and Mrs. George Crile, travelled by airplane from London to Moshi in Tanganyika Territory and at Arusha, joined Mr. Arthur B. Fuller of the Cleveland Museum of Natural History and Dr. Daniel P. Quiring of Western Reserve University, who had travelled by boat from London to Mombasa.

The new objective

In preliminary studies on the size relationships of the brain, thyroid and adrenal gland, made by the Cleveland Clinic Foundation and the Cleveland Museum of Natural History in the United States, a disturbing factor had been encountered which vitiated much of the data. This was the presence of enlarged thyroid glands in many of the domestic animals and in animals secured from zoos. It was imperative, therefore, if the research were to be continued, to carry on the study in animals not afflicted by goiter or by the abnormal conditions imposed by man. This was the task with which the expedition was concerned. The richest territory in the world as far as abundance and variety of animal life are concerned is in Africa in the vicinity of the great crater of Ngorongoro. This area, therefore, seemed to offer us the greatest opportunity for the furtherance of our research.

The selected site was a camp called Maji Moto some ninety miles west of Arusha in Tanganyika territory. This camp lies at the base of the high west escarpment of the Rift Valley about sixty miles from the great crater of Ngorongoro. It was ideal for our purpose since a great deposit of volcanic ash, the tropical sun, the abundant rainfall and the vicinity of Lake Manyara, a great soda lake, produced an abundance of plants and trees and hence of animal life.

Among the great animals

On one side of us was dense bush in which were many rhinoceros and buffalo; on another, swamp and lake in which the hippopotamus makes its home; at the foot of the escarpment was a great mimosa forest in which were herds of elephants and several species of monkeys. Between the forest and lake was a grassy plain on which zebra, impalla, kongoni, wildebeest and other herbivorous animals grazed. Feeding on these herbivora were the carnivora—lion, leopard, hyena and jackal. Various species of smaller cats (serval, genet and civet) found shelter in the forest, and all around and above us, especially in the vicinity of Lake Manyara was a great variety of bird life including vast numbers of European storks and unbelievably large gatherings of flamingoes. Locusts and other insects on the grassy plain gave sustenance to the abundant bird life.

Here we set up our laboratory and established ourselves for almost two months of intensive work. The native type of hut was used for the laboratory and for shelter as well as for the camp. The birds and smaller animals which could be easily transported were dissected in the laboratory, but the larger animals—lion, hippopotamus, rhinoceros, elephant, etc., were dissected where they fell, the various glands and tissues being taken to the laboratory for preservation and packing. Some of the smaller animals were embalmed and sent back to our laboratory at the Cleveland Clinic Foundation to be dissected there.

Many specimens

Representatives of all the true vertebrate classes with the exception of amphibia were obtained. Of a total of 220 animals, 108 dissections involving the eyes, the thyroid gland, the adrenal-autonomic complex, the brain, heart, lungs, liver and kidneys were made in the field. All these organs were weighed and examined before they were packed for shipment, and in addition in a number of animals, gastro-intestinal, muscular and skeletal weights were determined also.

The dissected animals included fishes, turtles, lizards, birds, rodents, carnivora, perissodactyls, artiodactyls, one proboscidian, hyrax, and primates. In addition to these specimens, 118 bird skins were preserved and a chimpanzee, a baboon, two gray monkeys, two vervets and two snakes—a python and a green mamba—were embalmed for dissection in Cleveland. A large amount of skeletal material was saved. In some instances, only the skull and the skin mantles were preserved; in others, the entire skeleton and skin were kept.

Back of the purpose of the expedition already briefly stated, lies the following general thesis:

Man seems to be peculiarly susceptible to certain pathological disturbances affecting the nervous system and the endocrine glands, diseases which are generally unknown in the other vertebrates. The question presents itself therefore as to whether these disturbances might be explained on the basis of possible structural differences between the nervous and endocrine mechanism of man and of the remaining backboned animals, or whether they might simply be caused by man's subjection to a set of conditions to which as yet he has not become biologically adapted. Closely associated with this question a further one arises, namely, if structural differences exist in the endocrine-autonomic mechanism of man as compared with various animals, might this be the cause of the difference in activity patterns of the various animals, since the endocrine-nervous mechanism governs energy expenditure.

With the general acceptance of the theory of evolution, the medical and biological professions generally have stressed relationships between the various vertebrate classes, including man as a member of the primates. But a result of this tendency has been the overlooking or underemphasizing of certain other marked differences between man and his fellow creatures. The anatomist is aware that man possesses a relatively large brain, which expresses itself in superior intelligence, but he is often so fascinated by his study of structure, by the beauty of the story which unfolds itself when he proceeds from the evolutionary point of view, that he too commonly fails to consider man as a distinct problem. He does not generally look upon the organism as a dynamic energy-spending system in which the skeletal-muscular machine requires also an energy-liberating mechanism for its successful self-maintenance. While function is the true province of the physiologist, the necessary restrictions which his special field place upon him may make him generally oblivious to some of the unique characteristics of man or to the organism as a dynamic system whose various functions may be resolved into one great function—the employment and the liberation of energy.

The rôle of the thyroid

The thyroid gland governs the metabolic rate of an animal. In a highly active animal one would expect a correlation between thyroid size and bodily activity. But this is not a simple relationship, as becomes evident when an additional factor is considered, namely, body surface, which determines to a large measure the amount of energy lost as heat. In addition, the thyroid has a definite effect in sensitizing the body to adrenalin, so that the evaluation of the interrelationship of the thyroid and adrenal becomes necessary to an understanding of the true rôle of the thyroid in the body mechanism. Its secretion, thyroxin, is a definite requisite for orderly body growth and normal mental development.

The adrenal glands have been called emergency glands since they supply the energy to meet sudden emergencies. This response is due to the activity of the medulla of the gland,* which secretes adrenalin under stimulation of the sympathetic system. The stimulation originates commonly in the sensory organs, although internal states may initiate its activity. One might expect a relatively large medulla in animals which are confronted with frequent emergencies and which depend upon sudden outbursts of energy for attack or escape.

It seemed desirable to examine this thesis by subjecting a wide range of animals to dissection and evaluation of these particular systems. Since such differences exist, they might well express themselves in relative differences in the weight of the glands or in the degree of complexity of their innervation, i.e., in the autonomic system, or in structural differences. Differences in the potency of secretions in the absence of differences in size or complexity are, of course, not excluded.

A remarkable ratio in man

The earlier studies referred to above had pointed definitely to differences in the relative sizes of the thyroid, adrenal and brain and in the complexity of the autonomic innervation of the adrenals in various animals. For instance, an examination of some 600 animals disclosed that the ratio of the adrenal to the thyroid weights in the rodents ranged from 2:1 to 12:1. In the carnivora, this ratio of adrenal to thyroid weight was 1½:1 to 2:1. In the birds, the ratio of adrenal to thyroid weight was approximately 1.25:1 and in the primates generally the ratio ran from 1½:1 to 6:1. It was only in man that a converse relationship was discovered, for in man alone the thyroid exceeds the adrenal in size. This relative size is expressed by the remarkable ratio of adrenal to thyroid weight of 1:2.4.

A microscopic examination and an evaluation of sections of the adrenal glands of the alligator, the lion and of man showed that in the alligator, medullary tissue makes up about 6.69 per cent of the gland while in the human adrenal the medulla makes up approximately 14.16 per cent, and in the lion the medulla makes up approximately 24.32 per cent of the gland.* Thus, if approximately 24 per cent of the lion's adrenal consists of medulla, the ratio of adrenal medulla to body weight in this animal would be as 1:22,565 in an animal weighing 190.85 Kg. with an adrenal weight of 34.64 grams. In a human being weighing 65 Kg. with an adrenal weight of 10.7 grams, the ratio of adrenal medulla to body weight is 1:54,805. In an alligator of 109 Kg. with adrenal glands weighing 5.8 grams this ratio becomes 1:280,951. While these studies were made on single glands, in each case histologic examinations of adrenal bodies from other lions, human beings and alligators, indicate that the lion generally contains a considerably larger amount of adrenal medullary tissue than does the human and certainly a vastly greater amount than does the alligator.

This, then, is the general outline of the thesis on which our investigation proceeded, together with a few of the provocative findings which made this African expedition such a promising adventure. It is not the purpose of this paper to present a detailed report of our African findings. The data are now in the process of being evaluated and will, it is hoped, be made available in due time.

Tentative conclusions

Sufficient regularity appears in our findings, however, to warrant some tentative conclusions; fuller scrutiny of the material is required to appreciate certain implications in the weight and dissectional data. The specific difference in the thyroid-adrenal ratio and in the thyroid-body ratio which appeared to exist in man as compared with other animals on the basis of our earlier work in the United States, has been confirmed so that it may be stated definitely, we believe, that man stands in a unique position with reference to these relationships. A further tentative conclusion is that the gross size of the adrenal body seems to be a function of the body mass but that the size of the medulla is further governed by the activity pattern of the animal or, conversely, the physical activity pattern of the vertebrate body is determined by the mass of the adrenal medulla. A further fact which stands out is the marked difference in the complexity of the innervation of the adrenal body and the adrenal-autonomic complex in various animals. There is, of course, a definite evolution of the adrenal body and the autonomic system when one passes from the fish and the reptile to the mammals. Within the individual classes of vertebrates, however, marked differences in the degree of development of the gland and of the autonomic system occur.

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* The cortex of the gland serves another function.

* These figures are based on approximations made with a planimeter upon sectioned glands.

We return to the question of whether man's peculiar pathological disturbances are determined by the unique relationships which exist between his thyroid gland and his body. To this one may answer that since this difference does exist between man and other vertebrates and since this gland does play the central rôle in body metabolism, it is reasonable to suppose that its frequent hyperactivity resulting in a variety of pathologic states may be due to its unique size relationship. This view receives additional support when it is considered in relation to man's peculiar biological mode of life and when the inter-play of the adrenal and thyroid glands is considered.

Activity pattern of animals

The further question which is naturally raised by our initial hypothesis is: May we ascribe differences in the activity-pattern of animals to specific differences in the degree of development of the thyroid gland, the adrenal body and the autonomic system? This may be answered affirmatively, we believe, on the basis of the mass of evidence which has accumulated in the past few years on the central rôle of the adrenal and the autonomic system in stepping-up the rate of energy expenditure, as well as on the basis of the body of evidence we are accumulating with reference to the changes in medullary size correlated generally with physical activity.

We cannot omit a word of appreciation for the kind of coöperation given us by his Excellency Sir Harold McMichael, the Governor of Tanganyika Territory and his Staff as well as to Captain P. C. Hallier, Provincial Commissioner with headquarters in Arusha, and Captain P. Teare, Chief Game Warden for the district.

His Excellency, the Governor, granted us special permits which enabled us to secure a number of specimens which are ordinarily protected. On the basis of their extended experiences in the territory, the provincial Commissioner, P. C. Hallier and the Game Warden Captain Teare gave us much valuable information concerning the habits and the location of some of the animals we desired to secure.

We are indebted also to his Excellency P. Enen Mitchell, the Governor of Uganda Protectorate, for his kindness in granting us special permits to secure a pair of chimpanzees in the Protectorate. District Officer James at Massindi in Uganda Protectorate too was most helpful in aiding us in the completion of the necessary arrangements for the safari in the search for chimpanzees. Captain R. Salmon, Game Warden for that area also lent us the benefit of his experiences and if it had not been for these individuals, it is doubtful whether we could have secured our chimpanzees.

Captain J. R. H. Hewlett acted as our professional hunter and guide. Captain Hewlett, who has his headquarters at Moshi in Tanganyika Territory, knows the country and the game animals well. He was indefatigable in his efforts to make our expedition a success. The members of the expedition are unanimous in their feeling that one of the chief factors which made our safari such a pleasant and successful experience were the efforts of this fine personality. It is our unanimous hope that we may meet and work again with Captain Hewlett.

Outposts of Baja California

Desert islands where a vanishing fauna is making a valiant struggle to survive

By JOSEPH R. SLEVIN
Curator of Herpetology, California Academy of Sciences

OFF the coast of Baja California lie a number of islands and islets harboring a vanishing fauna. The northernmost of these, Los Coronados Islets, are not far from the southern border of the United States. Others are scattered along the shore to the southward as far as Santa Margarita Island, and one group, the Revillagigedo Islands, lie almost 400 miles southwest of the tip of the peninsula.

History

It is from the missionaries that we get much of the early history of these islands. The records show that as early as 1732 Father Taraval, after a wandering journey of some six days from San Ignacio, came upon a great bight in the coastline of Baja California, which he named Bahia San Xavier. From this site he made out two islands six or seven leagues off shore, and with the aid of the Indians Father Taraval constructed a raft on which he reached them.

The nearer one, Natividad, he named Afuega, or Island of Birds, because of the great number of sea birds he found, the only living things he saw on the island. The further island, Cedros, discovered by Francisco Ulloa in 1539, was known as the Island of Fogs. Climbing a high mountain on this island Father Taraval saw to the westward the San Benito Islands, and far to the northward another island, which was undoubtedly Guadalupe.

For the naturalist who is partial to the desert these islands are particularly attractive, their fauna and flora being so characteristic of it. Unfortunately most of those who have been lucky enough to visit them have lacked adequate time for study and exploration.

Although mostly insignificant in size, and with one or two exceptions harboring no spectacular animal life, these islands are a never-ending source of interest to the naturalist. A commercial world, however, which unfortunately knows naught but of dollars and cents and cares nothing for the future, has practically exterminated the fur seal, the sea otter, and the elephant seal. Only strict government protection and supervision can save what is left. The Mexican Government now has laws protecting the fur-bearing animals and the sea elephants, so that there is fortunately some hope of their surviving.

A tale of destruction

For the near, and in some cases complete, extermination of the land birds it is principally the commercial fisherman we have to thank. In order to facilitate their work the fishermen, especially those collecting the abalone, a valuable shell-fish, establish camps ashore, some of which are quite temporary. The custom has been to have a camp cat or two, and when the camp was abandoned these cats were left to run wild. Needless to say, having nobody to feed them, they resorted to hunting for their food, the small land birds being the first to go. Mr. A. W. Anthony, well-known ornithologist of the Pacific Coast, who became acquainted with the islands in 1887, found that on the San Benito Islands McGregor's house finch (*Carpodecus mcgregori*) had become almost extinct in a period of twenty-five years.

Guadalupe Island has been called a biological sepulcher and is a shining example of what can happen when domestic animals are introduced and allowed to run wild. Formerly the home of numerous small land birds and described as a paradise by Edward Palmer, the first naturalist to visit it, the island now harbors only a remnant of what there used to be. The flicker, towhee, kinglet, crossbill, and Guadalupe wren have already been exterminated not to mention the Guadalupe caracara. The goat herders can rightfully be charged with the extermination of the latter bird. Claiming that it attacked the young kids, the herders methodically shot the birds as they gathered about the water holes; and it was not long before the Guadalupe caracara went the way of the great auk and the passenger pigeon. The Guadalupe petrel fell an early victim to the cats. The animals had only to wait at the mouth of a burrow for the bird to emerge bound for its feeding grounds on the high seas. Thus it was that this one-time paradise came to an end.

It is reported that many years ago a whaler, following a common custom of the early mariners, left some goats on Guadalupe Island in order to enable subsequent visitors to obtain fresh meat. While in some cases this may have been the means of saving shipwrecked sailors, it led to the destruction of the foliage, and it might be said in some cases to the island itself.

Death to vegetation

On Guadalupe the goats increased to such an extent that by about 1887 concessionaires were shipping to the mainland some 15,000 goat skins a year. They and many others later, found it to be unprofitable, however, and the goats ran unmolested, occasional droughts being their worst enemy. They have exterminated many species of plants, and only those which grow on sheer precipices will survive for any length of time. The scant forests of oaks, pines and cypress, on the tops of the northern ridges, must in time disappear. Natural causes, such as old age, storms, etc., will account for the disappearance of some of the trees but the goats in the end will take care of the rest. Even now they have the bark chewed off wherever it is within reach. No seedling is allowed to survive, and no acorn will ever mature. Thus the disappearance of the Guadalupe forests is inevitable.

About the year 1880 the Guadalupe fur seal (*Arctocephalus townsendi*) was exterminated as far as commercial hunting was concerned and for years afterwards the animals were considered extinct. It therefore created considerable excitement among naturalists when, in 1928, two fur seals were brought from Guadalupe to San Diego by some local fishermen. It is evident that a small remnant of the herd had escaped the slaughter and had hidden away in inaccessible caves unknown to the sealers and poachers.

About the south end of the island may still be seen the remains of stone huts built by the sealers, and driveways up which the animals were driven to the slaughtering ground. The rocks that were polished by countless numbers of seals passing over them in bygone ages are distinguishable, and even the pegs driven into the ground to set taut the skins for drying are still in evidence, mute reminders of the hardy adventurers of early days.

Home of the sea elephant

By far the most spectacular animal of the Baja California outposts is the sea elephant, or elephant seal, as it is sometimes called, a huge animal weighing several tons and reaching a length of twenty-two feet. These animals fell before the onslaught of the whalers who prized them highly for the oil obtained, and like the fur seal they were hunted until the exploitation was no longer profitable. These creatures fared somewhat better than the fur seal, however, and today there is a fair-sized herd (some 500 or more animals) making their home on a sand beach at the northwest end of Guadalupe Island, where they are protected by towering cliffs which make it impossible to reach them from the land side. As this shore has the whole Pacific Ocean to beat on it, it is only on the finest and calmest days that a landing can be made. This, coupled with the fact that the Mexican Government has passed stringent laws protecting the herd, may enable it to increase in years to come, so that it may once again reach its former state.

Cedros Island, one of the largest of the coastal islands, is nearly 21 miles in length and rises to a height of 3959 feet at the northern end. It is rapidly sharing the fate of Guadalupe. The abalone fishermen have found it a fertile fishing ground and have established a camp at the southern end as their headquarters. To furnish fuel for boiling the abalones before drying them they have stripped the nearby canyons of vegetation and in their boats have gone farther afield, touching all the canyons along the eastern shore, and cutting out all the small trees. Where there were once picturesque little canyons spotted with juniper trees, which gave shelter to the native deer, there is nothing left but desolate rocky dry washes, where even a horned toad would have difficulty in finding a shady spot to escape the heat of the noonday sun.

Slaughter of deer

Serious inroads have been made on the deer to furnish meat for the abalone camp. The few that have escaped the slaughter hide out on the steep slopes of the northwest end, where a scattering of brush and trees furnishes a meager shelter. Owing to the fact that it is a long hard pull back to camp the few remaining animals may be saved for the time being; but it may be only a question of a comparatively short time before their doom is sealed.

Bird life is somewhat scarce on Cedros. Say's flycatcher, large-billed sparrow, desert sparrow, Costa's hummingbird and a few other species are represented. All visiting ornithologists have remarked about the scarcity and wildness of the small land birds on this barren and windswept island.

Leaving the coast islands and heading southwestward from Cabo San Lucas, the southernmost point of Baja California, we find two interesting islands, Socorro and Clarion, of the Revillagigedos. Socorro, the largest of the group, is a mountain peak rising out of the sea to an elevation of 3500 feet and visible at a distance of seventy miles. Its inhospitable shores must be approached with care as anchorages are poor and the winds at times strong and uncertain. The lower levels of the island are densely overgrown with brush, making traveling an arduous task. A casual observation from the deck of a vessel gives the traveler no idea what he must encounter before reaching the summit. Socorro shows signs of volcanic activity, and just below the summit are blowholes from which steam escapes in small clouds, and hot mud flows from miniature craters.

Fortunately Socorro has not been used for fishing camps and a most interesting bird population remains there; but now that commercial fishermen are going far afield for their fishing grounds it will only be a question of time before it meets the fate of all the coastal islands. The usual shore birds, such as the yellow-crowned night heron and the wandering tattler may be found commonly about the rocky beaches, but to see the bird life in all its variety one must climb the mountainside beyond the rank growth of brush. There the traveler emerges into a tree belt that any ornithologist would give worlds to visit. Here may be found large flocks of the beautiful Socorro paraquet feeding on the fruits of the native trees, or equally large flocks of the Socorro mourning dove, fearless at the approach of man as it walks about the ground. The Socorro red-tailed hawk may be seen soaring overhead as it searches for its prey. In short, pencil and notebook must constantly be in use in this ornithologist's paradise.

A bird of the lower levels is the Socorro elf owl *(Micropallas graysoni),* which as its name suggests is a pigmy among owls. It bears the name *graysoni* after Colonel Andrew J. Grayson, who, in the year 1867, made a private expedition to the Revillagigedo Islands and lost his vessel on the south coast of Socorro at a spot now known as Grayson's Cove, a small indentation in the coastline of Cornwallis Bay. In 1925 some of the dried out planks of his vessel, then worn almost to the thinness of shingles, were found on the rocky beach by the Expedition of the California Academy of Sciences to the Revillagigedo Islands on board the *USS Ortolan,* M. M. Nelson, Lieutenant, U. S. Navy, Commanding.

A life-saving spring

On reaching shore from the wreck Colonel Grayson's first thought was of water, the lack of which is the dread of every mariner unfortunate enough to be shipwrecked on these inhospitable shores. By good fortune a member of his crew discovered a small stream of water gushing out of a seam in the rocky cliffs. It is partly concealed by a pile of boulders, and covered by the sea at high tide, thus making it very difficult to find. It would no doubt have been taken for tide water were it not for the fact that the birds were seen drinking from it. This spring would be the only salvation for the shipwrecked mariner, at least in the dry season, and it is so well concealed that since Grayson's discovery it had escaped detection until the Academy's expedition of 1925. Before leaving on this expedition Colonel Grayson's account of his trip was consulted, and the spring was found just as he had described it. This all-important discovery was made known to the United States Hydrographic Office, so that future Coast Pilots, or supplements, may contain this information. In order to facilitate locating the spring a large W, filled with white cement, was carved in the rock, with an arrow pointing to the water and an inscription.

Fortunately for Colonel Grayson he "picked" a particularly nice place to be wrecked, for aside from having the spring at hand, the back of the beach was covered with a thick growth of trees, giving both shade and firewood. If he had tried all the beaches on the island he could not have found a better one. The adjacent waters abound in fish and there are plenty of sheep, in a half-wild state, scattered over the island from the seashore clear to the summit.

The original stock is said to have been placed on the island, in 1869, by John Smith, who obtained authority from the Mexican Government to make use of it as a commercial venture. He also introduced some twenty-five head of cattle, but most of these died and the remainder were killed for meat. The sheep fared better and multiplied considerably, notwithstanding the intense heat and the rough character of the country.

Isolated island fares better

Less visited than Socorro on account of its isolated position some two hundred and fourteen miles to the westward is Clarion Island. Although much smaller than Socorro it is interesting because it is seldom visited and the fauna and flora still remain in their natural state. The tameness of the birds reminds one of the far-off Galápagos. The little ground owls can be approached and chucked under the chin without their showing the slightest fear.

Great numbers of sea birds make Clarion a nesting site, and boobies, frigate birds, tropic birds, and the usual shore birds, such as curlew plovers, turnstones and great blue herons, are found along the coastline. One striking feature of the fauna of the island is a large reddish-brown snake *(Coluber anthonyi)* resembling the red racer of our southern deserts. They are found abundantly about the *Opuntia* patches, and it may be safe to say that Clarion Island is one place where you can go ashore and be sure of finding plenty of snakes. How they reached the island is a problem yet to be solved. It is a significant fact, however, that no snakes have ever been found on the neighboring island of Socorro, much nearer to the mainland.

Every visitor to Clarion remarks about the wonderful growth of cactus covering the southern slopes of the island. A great carpet of *Opuntia* spreads over the landscape and it is only in the thinner areas that it is possible to get through, and then only with the aid of a machete. To make things more interesting the top of the cactus growth is covered in many places with a carpet of morning-glory vines, forming an impenetrable tangle. The northern slopes of the island offer quite a different aspect, being fairly open and covered here and there with patches of long grass. In these nest thousands of Townsend's shearwaters *(Puffinus auricularis)*, their burrows honeycombing the hillside so that in certain areas walking is somewhat of a problem.

Wild life demands protection

Now that fishing vessels go great distances out to sea in quest of the deep sea fishes it may only be a question of time before Clarion meets the fate of the coastal islands. Only its poor anchorage and the lack of suitable landing places may help to postpone the destruction of this interesting fauna. Sulphur Bay, the only anchorage, is an open roadstead and affords poor shelter, being exposed to all southerly winds. The landing place, in a small cove to the westward, is dangerous even in calm weather on account of the unexpected swells that roll in from an apparently calm sea, and a vessel may anchor for days, or even weeks, without being able to put a landing party ashore.

If the Government of Mexico can enforce the laws protecting the wild life of these islands there may be some hope of saving the fur seal and the sea elephant from extinction; but the land birds will have a difficult time to survive. The disappearance of the wild life of any land is regrettable, and it is slowly but surely happening here.

Outposts of Baja California

(Above) A scene on barren, windswept Cedros Island, one of the "outposts" off the coast of Mexico. At the top of the ridge can be seen a straggling pine forest, while below it is a scattering of dwarf juniper trees

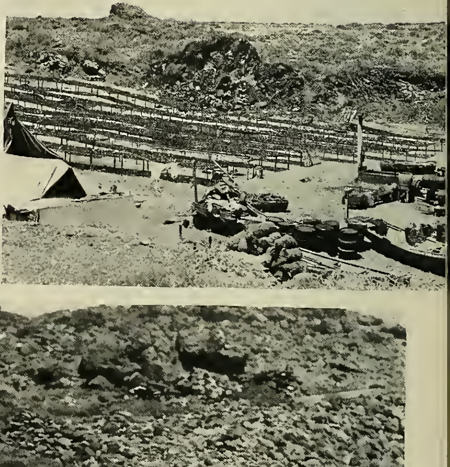
Photos by G. Dallas Hanna. California Academy of Sciences

The above photograph shows a grotesque elephant tree which stands as a sentinel on a rocky promontory of Cedros. The beautiful pink flowers of these trees when in bloom lend almost the only touch of color to the island

(Right) Frigate birds are abundant on many of Baja California's outposts and San Benedicto Island is no exception. The inflated crimson pouches of the males on the nests make the ground appear as though covered with a great red blanket

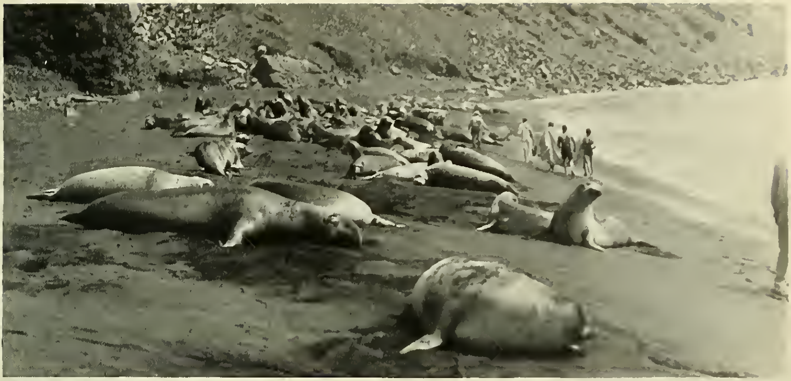
A herd of sea lions on the San Benito Islands. Formerly the sea elephant, sea otter, and fur seal made these three small rocky islands their home, but the fur bearers are gone and all that remain are the sea lions and occasionally a few visiting sea elephants from the Guadalupe herd (Photo by W. Chas. Swett, Courtesy of the G. Allan Hancock Expeditions)

(Right) Drying abalones on West San Benito Island. The use of diving suits by the Japanese fishermen and the indiscriminate gathering of the abalone, regardless of size, will in time result in its destruction



Photos by G. Dallas Hanna,
California Academy of Sciences

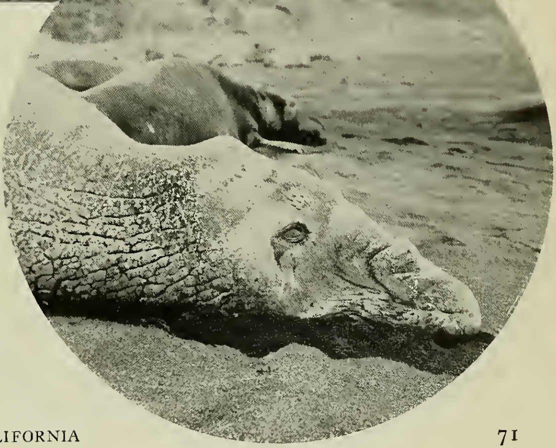
(Below) Where the sealers once carried on their trade: at Melpomene Cove, Guadalupe Island. The derelict dory shown in this picture might tell a story if it could speak, but nothing was found to indicate from where it had come



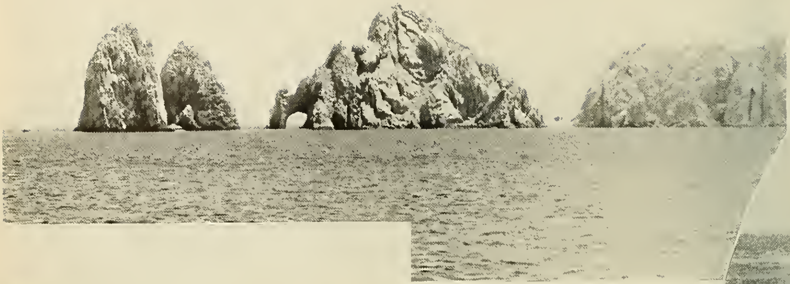
It is possible to walk amongst the sea elephants at Guadalupe Island without disturbing them in the least—after you have landed. But natural obstacles make this beach well-nigh inaccessible (Photo by W. Chas. Swett, Courtesy of G. Allan Hancock Expeditions)

(Left) The sea elephant knows how to relax, and although this one may appear lifeless, such is by no means the case

Photo by G. Dallas Hanna,
California Academy of Sciences



(Right) The head of a basking sea elephant: not a thing of beauty but a curious looking creature to say the least (Photo by W. Chas. Swett, Courtesy of G. Allan Hancock Expeditions)



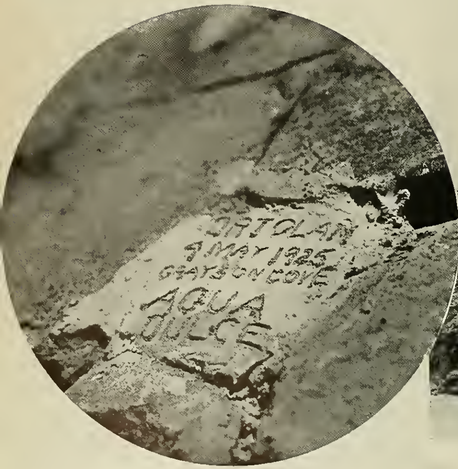
(Above) Cabo San Lucas, at the southern tip of Baja California, is a famous headland and a useful landmark for all passing vessels

(Left) Grayson's Cove on Clarion Island where a spring of fresh water saved the lives of Colonel Grayson and his crew when shipwrecked a half century ago

(Below) The cement plaque left by the U.S.S. Ortolan *to direct mariners in emergency to the spring*

(Lower right) Monument Rock, one of the prominent landmarks off the coast of Clarion Island

Photos by G. Dallas Hanna, California Academy of Sciences



Photos by W. Chas. Swett, Courtesy of the G. Allan Hancock Expeditions

(Above) Sea elephants under observation on the beach of San Benito Islands. The sea elephant is the most spectacular animal of these outpost islands. The Mexican Government's stringent laws may enable it to increase to its former abundance

(Above) A large bull sea elephant poses for his portrait. These creatures weigh several tons and reach a length of twenty-two feet

Two Scenes at Fallodon

(Above) The larger of the two ponds on the estate of the late Lord Grey, where over twenty species of wild ducks make their home.

In the lower picture Lord Grey is seen seated at the side of this pond feeding an American canvasback, one of a brood of birds hatched at the pond-side, which after an absence of seventeen months returned and fed from his hand the day of its arrival. From this side one looks across the pond to Fallodon as shown in the upper picture.

These two photographs are reproduced from an article by Lord Grey in the September-October, 1932, issue of NATURAL HISTORY

Memorials to Lord Grey

Plans to perpetuate the ideals of a man who strove for international harmony and a broader appreciation of Nature

THE General Committee of 69 formed in England to create a memorial to the late Viscount Grey of Fallodon has issued an appeal for support which, in a few words, admirably states its objects. It reads:

"Lord Grey is remembered as the statesman who fought so long and so hard the losing battle for European peace; and who, amid the blinding passions of war, with failing health and eyesight, never lost his mental vision of two main principles of his practical idealism, the necessity of friendship between the British Empire and the United States, and the necessity of some collective security for future peace, which from the first he strove to see embodied in a League of Nations.

"He is remembered also as the lover of nature. In writings that combine the poetry and the science of bird observation, he has taught many to find the purest and most lasting joys of mind and heart.

In public and private life

"Yet the two aspects of his life are not to be dissociated. If the strength, integrity and simplicity of his character made him for eleven years the notable representative of his country before the world as Foreign Secretary, and helped to give to the British Empire and her Allies confidence and unity at the supreme crisis of fate, these qualities were drawn from the same well-springs of old English rural life which inspired him as a countryman, a naturalist and an author.

"We therefore propose to erect to his memory a threefold memorial:

"1. To set up a statue or bust in a central spot in London.

"2. To acquire and make over to the National Trust 'Ross Castle', the small hill-top crowned by an ancient earthwork which adjoins Chillingham Park in Northumberland, a favourite view-point of Lord Grey's which he often visited from Fallodon.

"3. To develop (by further endowment and otherwise) the existing scheme of research maintained by the British Trust for Ornithology at Oxford, of which University he was an undergraduate and in later years the Chancellor, to form a permanent Institute of Bird Studies, to which his name would be attached."*

The bond among nature-lovers

It is the last-named object that will most strongly appeal to those who will welcome an opportunity to pay their tribute to the memory of Lord Grey. Busts and "National Trusts" have their places, but this plan to form a living memorial which, we may assume, would not only increase our knowledge of birds but would aid in promoting that relation between birds and man, the value of which was so eloquently demonstrated by Lord Grey himself, transcends in its importance all national bounds and concerns nature-lovers throughout the world. We can readily imagine bird students of other nations seeking instruction at Oxford, and as the success of the "Edward Grey Institute of Bird Studies" becomes apparent, who can doubt that similar Institutes will become a part of other centers of learning? Here is the foundation of a League of Nations which might assure at least a bird protection under whatever flag it happened to find itself.

It may also be assumed that among the textbooks used by this proposed Institute a high place would be accorded Lord Grey's "Charm of Birds." While this work is dedicated chiefly to English passerine birds, their appearance and personalities, their place in nature and in literature, their association with the seasons, and especially their voices, it also records, with convincing enjoyment and wholesome sentiment, the value of birds as an expression of their environment.

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* Subscriptions to the memorial fund payable to J. P. Morgan & Company, may be sent to that firm at 23 Wall Street, New York City, who will remit them to the Barclay Bank, agents of the Memorial Committee in London.

Read, for example, what the "robust, buoyant" song of the chaffinch meant to its author. "If the chaffinch were human," he writes, "one can imagine that he would say 'Cheerio!' as a greeting to a friend. . . . One chaffinch stands out in my memory as does a single dipper and a single wren. It was in the Whitsuntide recess, when for a few precious days late in May or early in June I had escaped from Parliament and from London, whose 'season' is then so miserably unseasonable. The days were fine and bright. On a stone coping of a little parapet, that went around the roof at Fallodon, at a corner that faced due south, a chaffinch used to take its stand, and from that eminence pelted me with song whenever I went on the lawn outside. This one bird became a feature of the holiday, an embodiment of happiness proclaimed from the housetop. . . . For me the immortal spirit of those happy Whitsuntide days still lingers in the song of the chaffinch."

The whole book abounds in similar responses to the song and personality of birds. I quote once more to show how varied and far-reaching was their influence in Lord Grey's life. Wild ducks were the distinctive birds at Fallodon. Lord Grey had introduced over twenty species and from one to two hundred unpinioned birds were free to go and come. After describing graphically the early morning play of a group of these birds on the larger of his two ponds, as seen from a bench at the pond-side, he writes:

"All was quiet; there was no sound or stir; the water was again smooth, the reflections in it were composed once more; the sun still shone; on the water and the birds; on the scarlet-barked willows and the delicate bareness of winter trees on the opposite side. Anyone who had come upon it now might have thought that the place was under some spell. He would have seen the man on the seat sit motionless, too, for a long time; entranced rather than asleep; the scene had indeed sunk down into his heart and 'held it like a dream.' There are times when man's consciousness seems laid to rest in some great whole, of which he has become a part. There are hours of which it can be said, 'Thought was not: in enjoyment it expired.' So it was now, and if anything stirred in the mind at all, it was an echo of the words, 'And God saw that it was good.'"

FRANK M. CHAPMAN,
Curator of Birds, American Museum of Natural History

A scene from the Roosevelt-Grey Walk in the New Forest in Southern England, reproduced in the American Museum habitat group, which is dedicated to the memory of Viscount Grey of Fallodon

Diving Spiders

Intimate observations on a spider of India which submerges when frightened or in search of food, and preys upon fishes

By GOPAL CHANDRA BHATTACHARYA
Bose Research Institute, Calcutta

FAMILIAR with the rapid manner in which spiders move on land and with their web-spinning maneuvers in the air, many people do not realize that certain varieties have also attained astonishing mastery in the realm of water. To see them leap here and there on the surface of a river or lake is in itself a surprising sight, but most fascinating of all, perhaps, is their habit of submerging and remaining under water for considerable periods. Some are able even to prey upon small fishes.

A spider of this sort is *Lycosa annandalai,* whose activities it has been my fortune to observe in the neighborhood of Calcutta. I came across the specimens I am about to describe quite unexpectedly.

Searching for stick-spiders

I was strolling through the suburbs of Calcutta in the month of March when I came upon a stagnant pool. Though the center was quite clear of weeds, its shores were completely overgrown with aquatic plants and grasses of various kinds. Around the edges the big green leaves of the Colocasia drooped over the surface of the water. These plants were the abode of another variety of spiders, the red-brown and spotted black stick-spiders of the genus *Tetragnatha.*

These spiders, with the purpose of preying upon various minute insects that hover or walk upon the surface of the water, attach themselves to the leaves, stems, or stalks of the Colocasia, where they may easily be mistaken for dead sticks.

I was trying, in vain, to capture some of these interesting creatures when my attention was drawn to a well developed stick-spider, which was passing from one plant to another. As the water was only knee-deep, I tried to catch it, but as I reached out, the spider, detecting danger, leaped with great alacrity upon the surface of the water. Immediately a big gray spider, with spotted back, came running from an adjacent leaf of Nymphoides (*Limnanthemum nymphoides*) and jumped upon the poor creature in the twinkling of an eye. The victim struggled, only to expire within a minute and a half. The aggressor then dragged the dead animal to a blade of grass and began feeding on it.

A chase

I resolved to capture the creature that had made the attack. But as I approached, it jumped and ran away; and I eventually lost sight of it entirely among the grasses that stood out of the water. I splashed the water and disturbed the vegetation sufficiently to cause several others of different sizes and shapes to come out on the surface of the water. Greatly alarmed, they began to run hither and thither.

I singled out another specimen and pursued it relentlessly. Soon the creature became tired and ran no more, but folded all its legs and crumpled itself into a mere mass, resembling something dead. This black mass was floating in an inverted position on the water by the side of some Nymphoid leaves. The instant I placed my fingers on it to pick it up, to my utter surprise it disappeared suddenly and completely, where, I could not follow. I had been quite close upon the creature, but I could not detect the secret of its escape.

For perhaps a quarter of an hour I searched in vain. Thoroughly disappointed, I was about to give up the chase when suddenly just to my right, I saw a big spider emerge from beneath the water. The mystery of their hiding themselves so quickly was then solved. This large specimen with grayish-black back and bluish-white lines around the cephalothorax, had been lurking below the surface. I had had no idea that these spiders could dive under water, like otters and beavers. Since discovering this, I have scarcely ever failed in capturing them.

When frightened, they suddenly submerge and remain clinging to the aquatic plants; and I have often seen them stay below for more than twenty minutes. Because of an air film surrounding their bodies, they look silvery white under water. The coating of air prevents the water from moistening them. The mother spider, carrying a cocoon from which young will eventually emerge, dives under water in a similar manner and under similar circumstances.

The depth to which the spider dives is usually several inches, and if pursued, it creeps for a considerable distance under water along the aquatic plants and tries to hide itself in a place of safety. When exhausted and unsuccessful at concealing itself, it feigns death, folding all its legs and floating on the surface of the water in an inverted position.

In some respects, both the males and females are of similar habits and frequent the same places. But the males keep at a safe distance from the females, lest they be attacked by them. Though smaller in size, the males are more formidable looking and run more swiftly than the females.

Courtship

In the breeding season, the male idles here and there over the leaves or stalks of plants and grasses, or in bushes in search of a mate; while the female sits quietly under a bush or upon a leaf. When a male meets a female both remain stationary for some time. If the female moves, the male follows her keeping at a safe distance. If the female faces about, the male remains motionless as if dead. Presently the real courting begins and the entire operation takes a considerable time.

The observations I shall recount began about eight o'clock one morning at the edge of a stagnant pool at Kankurgachhi near Calcutta. I was squatting on a moist patch of land, when my attention was drawn to a small slender spider, which was moving in a peculiar dancing manner, repeatedly entering and leaving a small clump of aquatic plants and sometimes encircling the spot. It was not until later that I learned that his intended mate was lurking there. The male would advance toward the spot with very slow and cautious steps, counting paces as it were. He would raise his body to the maximum height and lower it again with a graceful movement of the pedipalpi, paying as it were homage to her majesty, with his head bowed down and both the pedipalpi folded. The pedipalpi were prominent and black, with femur and patella dorsally ornamented with bluish-white soft bristles.

Female larger

After a while, the spider advanced toward the bush, spreading his fore legs upward. Without stirring an inch from my place, but peeping through the plants, I saw what was happening inside. The female spider, much larger than the male, was resting on a floating Nymphoid leaf. When the male approached her, she raised her fore legs and chased him. The male kept quiet for a few minutes and then again approached her, dancing vigorously and vibrating his legs. If he appeared to be lacking in proper enthusiasm, the female would try to rekindle his interest by vibrating her hind or fore legs. The same procedure was repeated several times. Then, while the female still lay in ambush, the male, all of a sudden, approached her and clutched her tightly.

The preliminary dancing as I later learned sometimes lasts for hours; and the actual mating, in this case, continued for more than fifteen minutes. During this time, I managed to confine the pair, without disturbing them, in a glass tube. When the male released the female he remained motionless for a moment, then ran toward the end of the tube. Being unable to escape, he came back a few paces. Thereupon the female rushed upon her recent mate, caught him and stuck her fangs right through the cephalothorax. The poor animal died in a minute or two.

If one were to judge from her appearance and movements, the female was extremely furious. A few minutes later I introduced another male into the tube and the same lot befell it.

The female was kept in captivity, and after sixteen days she laid her eggs and encased them in a pea-like cocoon. It is curious that this specimen and all the others of various species that were kept in captivity, invariably laid their eggs at night. The mother spider under discussion firmly fixed the pea-like cocoon to her spinnerets and carried it continuously until the young were hatched, fifteen days later. Immediately upon emerging from the egg-sac, the young spiders, numbering 167 in all, got upon their mother's back.

Tenacious instinct

Once I detached the cocoon from the mother's spinnerets and put it at a distance. But the mother would not be separated from it. She attached it again to her spinnerets as often as I removed it. I pinned the cocoon to a lump of paraffin. The mother tried her utmost to snatch it away, and having failed attached her spinnerets to it and sat upon it. In this position no menaces would cause her to forsake her instinctive duty of guarding the egg-sac.

A mother spider cannot distinguish, however, between her own and another spider's cocoon. When her own cocoon was exchanged for that of a different species, the spider was quite satisfied with the substituted one. Several different cocoons, nearly of equal size, were mixed up. The mother spider was unable to recognize her own and was satisfied with whichever one she happened to pick up. It has also been observed that if an extra cocoon is offered, the spider will sometimes carry it with the side legs.

These amphibian spiders spend most of their time floating on water or resting upon leaves or stems of aquatic plants. But with the approach of evening they usually retire to land and seek shelter under cover of nearby vegetation. Sometimes they climb upon the leaves or stalks of grasses or creep under bricks and pebbles or into holes in the earth and rest there for the night. I could find no evidence of any retreat or resting place made by the spiders themselves either on land or in water. They are not regular weavers of webs or anything resembling them, but only spin a little for their cocoons. They are very quarrelsome. If a male or female happens to be in close proximity to another male or female a serious quarrel is inevitable. The duel ends in loss of legs, endangering the life of either or both of them.

The female lays eggs in a cocoon of a deep olive color, ornamented with several white spots. The cocoon is composed of two hemispherical cups of silk, joined together with loosely bound white web material, making a line along the equatorial region. With the gradual development of the eggs inside, this white band widens till it gives way for the exit of the young spiders. After coming out of the cocoon the young spiders flock into their mother's back and remain there for five or six days. These young ones are always in danger of their lives, for neighboring older spiders invariably kill them whenever they catch sight of them.

Fish hunters

Though they are of cannibalistic habit, these spiders prey principally upon the water-flies that float upon the surface of the water, the smaller dragon-flies, etc.; and they even hunt small fishes whenever there is opportunity.[1] After seizing their prey, they suck the juice out of it by inserting the fangs and crushing the victim with the powerful mandibles.

Sometimes they rest upon the clear surface of water, making little depression on the surface. They cannot walk slowly upon the water surface but cover wide stretches of water by quick jumps. But their most interesting activities are their maneuvers under water. These spiders, which have been identified as *Lycosa annandalai*, are only one of a number of kinds which have mastered in greater or less degree the aquatic medium, and provide a rewarding subject of observation for the naturalist.

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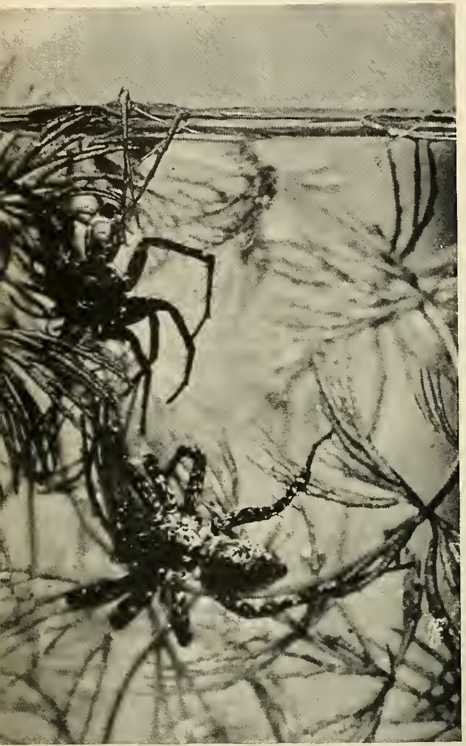
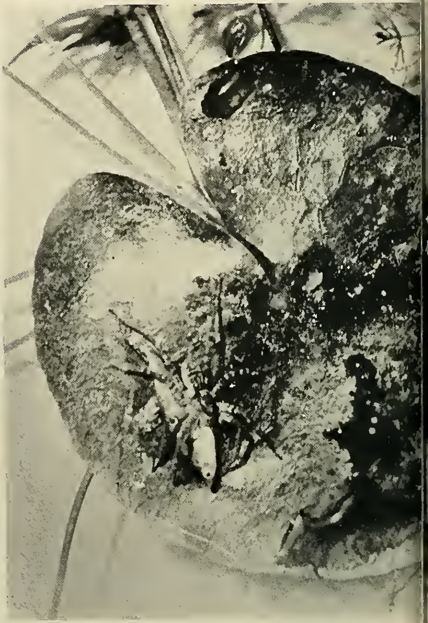
[1] The activities of spiders as fishermen have been described by O. Lloyd Meehean in Natural History for October, 1934, and by Dr. E. W. Gudger in Natural History for January-February, 1931, and in earlier issues.

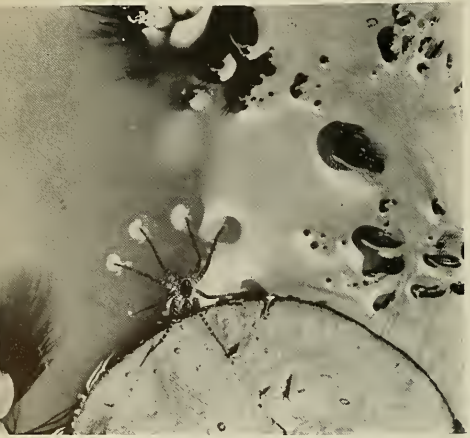


Diving

(Left) An interesting spider of India in a typical posture: Lycosa annandalai *which displays underwater tactics even more fascinating than the aerial maneuvers of the common varieties with which we are all familiar*



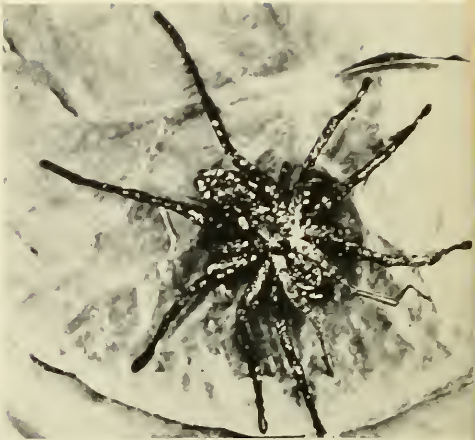
(Above) A spider with a true fish-story to tell. Although these spiders prey principally on insects, they also capture and devour small fish, from which they extract the juice by inserting their fangs and crushing the victim with their mandibles

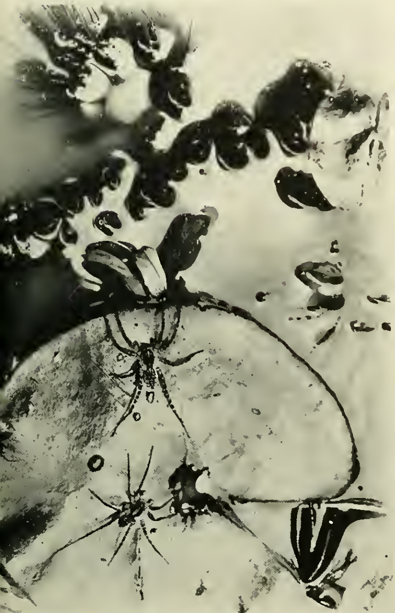


(Left) This spider is using the leaf of a water plant as a float from which to carry on his predatory activities. He searches the surface for water-flies and dives in quest of fish, remaining submerged for as long as twenty minutes

Spiders

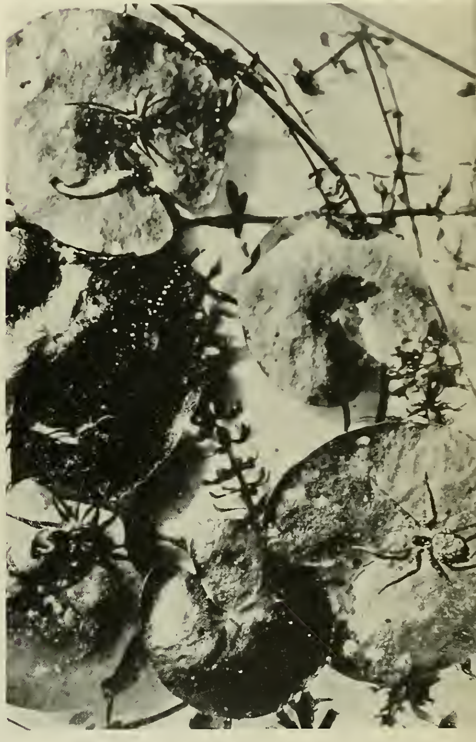
(Right) The mating of Lycosa annandalai. *The female was kept in captivity and after sixteen days laid her eggs and encased them in a pea-like cocoon. She would not allow this egg-sac to be separated from her during the fifteen days that preceded the hatching of her young*





In the above photograph the male is shown courting the female, which is the larger of the species. He approaches with slow and cautious steps, as though paying homage to her majesty. In the end the female kills her mate

(Right) A group of the spiders in their natural setting: males and females resting on Nymphoid leaves. At the lower right a mother is carrying her young ones, while at upper left and below, each spider has captured a fish



Science in the Field and in the Laboratory

Dedication of African Hall—Russian Eclipse Expedition—Meetings of Societies—City Bird Classes

African Hall Is Open

The dedication and opening of Akeley Memorial African Hall on May 19th was an event which many members have eagerly awaited.

The ceremonies were held in the Entrance Hall of the New York State Theodore Roosevelt Memorial, which adjoins African Hall. President F. Trubee Davison of the Museum presided before a large gathering of members and friends of the Museum and spoke on the distinctive features of this great exhibit. He gave acknowledgment to the various persons instrumental in the creation of the Hall and expressed the pride which all who have participated in it must feel in inviting the public to behold Africa, not as this or that person imagined it, but as it is.

President Davison introduced Mrs. Mary L. Jobe Akeley, who has been a vital force in the carrying out of the great dream which her husband did not live to see. Mrs. Akeley expressed her feelings in a brief paper, which because she was suffering from laryngitis, was read by Dr. Harold Anthony. Doctor Anthony, in turn, explained how the American Museum of Natural History has been a pioneer in the habitat method of exhibiting mounted animals, and pointed to African Hall as a climax in the development of museum art. He also described briefly the groups in African Hall and called attention to the precision that has been exercised throughout to preserve the effect of reality.

Dr. James L. Clark, who has been responsible for the entire preparational work connected with the Hall, was unfortunately absent from the ceremonies on a Museum expedition to Indo-China.

The great dream which Carl Akeley had of bringing Africa to America first stirred in him about a quarter of a century ago. When the dream was crystallized an African Hall Committee was formed on which Daniel E. Pomeroy has served continuously as Chairman. Mr. Pomeroy spoke at the ceremonies on the greatness of Carl Akeley from the point of view of an intimate friend.

Readers of NATURAL HISTORY are reminded of the January, 1936 issue of the magazine which was devoted to African Hall. Now open to the public, this superb display will acquaint thousands who might never otherwise see it with the wild beauty of Africa.

Doctor Fisher to View Russian Eclipse

On May 16th Dr. Clyde Fisher, Curator of the Hayden Planetarium, sailed on the Swedish-American liner *Drottningholm* for the first lap of his journey to Russia and Siberia. Doctor Fisher, as a member of the Harvard College Observatory Expedition, will take photographs and motion pictures of the total eclipse of the sun which occurs on June 19th, and which may be observed to the best advantage from the little hamlet in eastern Russia by the name of Ak-boulak. This eclipse will not be visible in the United States. While this total eclipse is an important phenomenon of great interest to astronomers in the study of the sun, it does not overshadow the second objective of Doctor Fisher's trip, which calls for a study of the great meteor craters in northwestern Siberia.

The Hayden Planetarium

During the month of June "The Midnight Sun" will be the subject of the lecture in the Hayden Planetarium. The demonstration will include a trip to the North Pole with several stops on the way to observe changing conditions as the latitude changes. The midnight sun and its apparent motions will be visible from the Arctic regions, as will also that beautiful spectacle, the aurora borealis or northern lights.

Amateur Astronomers Association

The Annual Meeting of the Amateur Astronomers Association on May 20th brought to a close the regular lecture-meetings for the season. The next regular meeting of the Association will be held on October 7th, after which lectures will be given on the first and third Wednesdays of each month. Members of the Association are hoping for fine weather and clear nights this summer. Trips are planned to astronomical observatories to examine observatory equipment, and, when possible, to look through large telescopes; other trips are to points on the outskirts of New York City for constellation study. These field trips begin with a visit to the Naval Observatory in Washington, D. C., on Memorial Day. All persons interested in obtaining notices of and further information about these amateur expeditions are invited to address the Secretary of the Amateur Astronomers Association at the American Museum of Natural History in New York City.

Junior Astronomy Club

Although the season of the Junior Astronomy Club was formally closed at a Jubilee meeting on May 9th, various activities will continue throughout the summer. The club is making a survey of the plans of numerous observatories for observation of the eclipse of June 8, 1937. This unusual eclipse will have a seven minute period of totality and will be unequalled for a thousand years except for the eclipse of 1955.

Meteors, variable stars, and other sky phenomena will be watched by members who will pursue their individual observations during the summer months.

Close Neighbors of the Earth

Between the orbits of Mars and Jupiter there is a belt of tiny planets called minor planets or asteroids. The total number of asteroids has been estimated at between 40,000 and 50,000. All of those observed go around the sun in the same direction as that in which the major planets move.

The astronomical world was interested in the discovery in 1898 of a small member of this group, which approached nearer the earth than Mars, and even nearer than Venus, which comes within 26,000,000 miles of the earth. This asteroid was named "Eros"; its diameter was estimated at 20 miles; and on account of the great eccentricity of the orbit, it was found to come within less than 14,000,000 miles of the earth. The orbit of this asteroid proved to be an improved yardstick in measuring the distance of the sun from the earth.

For more than a third of a century, Eros was the most neighborly of the known planets. But in March, 1932, an asteroid was discovered by Delporte of the Royal Observatory at Brussels, and later named "Amor," which is hardly more than 10,000,000 miles beyond the orbit of the earth at its closest approach. It is estimated to be not more than a mile or two in diameter.

In April, 1932, an asteroid was discovered at Heidelberg by Reinmuth, which approaches much closer to the earth than Amor. It is only about a mile in diameter, and at two points its path comes within three million miles of the earth's orbit.

In February, 1936, Delporte discovered an asteroid only about one-third of a mile in diameter, and consequently no bigger than a mountain on the earth. In fact, the asteroids in general have been referred to as "flying mountains." This tiny planet came within 1,500,000 miles of the earth, and is therefore our nearest known celestial neighbor except the moon and the meteors. After charting its path, Delporte named this newly discovered minor planet "Anteros," the mythological brother of Eros.

Early morning bird class of the American Museum of Natural History studying a northern water thrush in Central Park, May 12

City Birders

To the nature-loving New Yorker who is city-bound in the awakening months of April and May, Central Park offers surprising opportunities for study and recreation. To the expert, 100 spring species seen in the course of a month on two early morning rambles a week in Central Park may not seem especially significant, but to the New Yorker who longs to get to the country and cannot, it is thrilling.

The American Museum of Natural History, realizing the general interest in birds and the fine opportunities for study at hand in the Park, has been sponsoring, for the past five years, early morning walks during the migration season. To be greeted the middle of April by phoebes, robins, juncos, and even cowbirds after a long, cold winter is delightful. By this time, too, "Silver-tail," the albino grackle, is back to make his third yearly nest, and a flicker is loudly cuh-cuhing his approval of a maple to his mate for household purposes. Hermit thrushes, goldfinches, rusty blackbirds, and all too rarely a cardinal add their sweet voices to the middle April chorus. And on one dark morning a hump on a horizontal limb suddenly came to life in the form of a whip-poor-will. The sight of this bird, so seldom seen in the Park, was a real treat to the early birders.

One young enthusiast took to surprising the group with some pre-class discoveries. One morning he had spotted a yellow-bellied sapsucker at work and promptly led the group to the bitternut tree. The sapsucker, meanwhile, had disappeared and one student remarked that perhaps he had found the sap as bitter as the nut, but an even row of deep, little dripping holes in the trunk told the tale. Then some quick eyes spied him busily drilling at a neighboring tree, when we found that breakfast to a woodpecker came foremost on a chill morning, regardless of any curious lot of binocular devotees.

Last year two little screech owls chose an old pine near the West 77th Street entrance to the Park for their sleeping quarters. Upon first sight they looked like a knot on the rough bark, and the class was agog when they raised their heads and opened their large, sleepy eyes. Their admirers stop regularly this year to scrutinize the old pine, but so far without success. That is what makes birding so fascinating—the unexpected finds, the reunion with old bird friends, and the uncertainty of what may be in the next tree or around the corner.

As the migration season advances, birds come in a bewildering profusion. This spring a warm, south wind in the third week of April brought the first wave of warblers, golden-crowned and ruby-crowned kinglets, purple finches, blue-headed vireos, and others. Seeing thirteen species for the first time within an hour delighted the older students, whereas it dazed the beginners. In a month's time those seeking rarer species had heard the Cape May warbler sing his weak little song and the Tennessee warbler give his distinct "strident chappering." Some of the beginners had 75 life species to their credit—enough to keep them busy learning their habits the rest of the summer.

Although rare species of birds may still be seen in the Park, if there were more underbrush, soft earth, and green grass, as in former years, it is probable that many more would linger and rest in this city refuge while migrating. All New Yorkers who love birds and count them as their city friends should do their utmost to protect and improve the Park, to discourage vandalism, and to encourage and support the several sanctuaries that have been established.—Gladys Gordon Fry.

Meeting of the American Association of Museums

The Thirty-first Annual Meeting of the American Association of Museums was held in New York from May 11th to May 13th. On Tuesday, May 12th, the members of the Association were the guests of the American Museum of Natural History. In the morning a general session was held in the Theodore Roosevelt Memorial Auditorium, at which President F. Trubee Davison presided and greeted the delegates. At noon the trustees of the Museum tendered a luncheon to the delegates, and in the afternoon section-meetings were held in the classrooms of the School Service building. Some 400 were present.

Annual Dinner

The Annual Dinner of the American Association of Museums was the last event of the meeting and was held on the evening of May 13th in The Hotel Roosevelt. John H. Finley, associate editor of the New York *Times,* served as toastmaster and introduced the speakers, who included the following: Robert Cushman Murphy, of the American Museum of Natural History; Louis Cons, professor of French literature, Columbia University; and Vilhjalmur Stefansson, arctic explorer.

Doctor Murphy addressed the gathering of about 300 members and guests on the modern trends in museum aims: "Thirty years ago," he stated, "the museum idea had not . . . gone so far into the out-of-doors, much less into waves that travel around the earth via the stratosphere. . . . As I remember, many of the papers at the earliest meetings of this organization related to standardization of methods and equipment, a tendency which would have become the very bane of museums—institutions which must be individualistic and distinctive, if nothing else. What a revelation we have had this week in such more exciting titles as: 'The Film as a Museum Piece,' 'Showmanship in the Museum,' 'Research Service in the Museum Library,' 'Air Conditioning,' 'Infra-Red Photography,' and 'Objectives of Museum Work in National and State Parks.' . . . During the course of one short generation the whole museum idea has burst out from between the walls of discrete compartments, and from under solid roofs, and has entered the schools, camps, homes, even the forests, deserts, shores, and canyons of the wide world. Contrariwise, vastly more of the out-of-doors has been brought into the museums, so that indoors and outdoors are inextricably interwoven."

Doctor Murphy also pointed out some of the obstacles to the conservation of our national fauna and flora: "The settlers of our country were not originally woodsmen. They were husbandmen, traders, manufacturers, and they had been so for a thousand years in their old home. . . . These forbears of ours suffered, in short, from the fallacy of the inexhaustible. If forests were laid low, there were plenty more just beyond. . . .

". . . We are still largely possessed of a Yankee mania for drainage, which has been one of the most devilish of all our national habits. In the British Isles, as elsewhere in Europe, a marsh is treasured by any community, large or small. It is the place where the first spring blossoms emerge, and where gray herons, moorhens and waterfowl become almost as familiar and confident as barnyard birds. But in our own country the point of view of the 'realtor' has become so nearly controlling that most Americans look at a moist area filled with green rushes, meadow orchises, and pond lilies as something to be filled as promptly as possible with ashes, tin cans, and bedsprings. . . .

"But . . . we [in the museums] are not confined to the ordinary channels either of legalistic means or of scholastic education, and we well know that public opinion is far more effective than law."

The Fate of Grand Lake

In Rocky Mountain National Park, which was set aside in order to preserve in the National Park System a fragment of the most beautiful section of the Rockies, lies Grand Lake, the largest and loveliest lake in Colorado. But that beauty, and the existence of a large part of the present animal and plant population of the region is menaced by the proposition, now before the House of Representatives, to carry through the so-called Grand Lake—Big Thompson Transmountain Diversion Project. As outlined in hearings in the Senate, the plan provides for diverting water from the Colorado River in the southwestern corner of Rocky Mountain National Park through a tunnel under the continental divide into the Big Thompson drainage by a dam 190 feet high across a narrow gorge in the Colorado River. The Granby Reservoir, with 380,000 acre feet capacity, would be built at a cost of $1,370,000. The enlarged Grand Lake would be connected by a tunnel 68,700 feet long, nine feet in diameter, to cost $5,134,400. (Incidentally the estimate for the Moffat Tunnel was $6,000,000 and the actual cost $18,000,000.)

The cost of the entire project, including supply canals and a power plant, is estimated at $22,000,000. The water would be used to supplement existing irrigation systems which supply sugar beet areas now under cultivation.

Grand Lake will be ruined if this project is authorized, according to a letter received by Dr. H. E. Anthony from the American Planning and Civic Association, which points out that "the enormous amount of débris would undoubtedly create unsightly conditions of the worst sort near Grand Lake at the west side end of the tunnel and in the Park at the east end. See the entrance to Moffat Tunnel. The 8000 feet of conduit from the end of the tunnel to the east park line would introduce unsightly conditions which would last for many years and might never be obliterated."

The American Indian

A study of changes in American Indian population is under way in the department of anthropology at the American Museum. This study is based upon vital statistics for a number of Indian tribes in Canada and the United States over a period of fifty years, the compilation of which has been carried through by Mrs. R. D. Sanderson, honorary Life Member of the Museum. A brief report on this investigation has been published by Curator Wissler in the *Proceedings of the National Academy of Science*. This publication deals especially with the peculiar excess of adult women among the Cree Indians. It was observed that among one division of the Cree the sex ratio was 199 men to 243 women. In most populations of the world there are but small differences between the number of men and women. The publication issued is a discussion of the probable causes of this phenomena. It was discovered that among minors the number of males was but little less than the number of females, thus making it obvious that there was a higher death rate among near adult males. Further analysis of the data revealed that the high death rate for males began about the sixteenth year and continued to about the twenty-fifth year. There is no known disease that is selective in this way. On the other hand, the information concerning these Indians indicated that they were hunters and trappers and that most of the deaths among males for the period were believed due to accident and exposure. In brief, it was possible to show that this example of extreme differences between adult males and females was entirely due to mode of life. These Indians were first placed upon reservations about 1880, the statistics on their population begin a few years later, and since there was an even greater excess of women at that time than in 1934, we believe that under original primitive conditions there was a still greater number of women. In 1805 a fur trader reported that there were 76 men to 212 women. The significance of the data compiled by Mrs. Sanderson is that we see the hunting, warring life of the aboriginal Indian as especially destructive to males.

Incense Burner for the Morgan Collection

The Morgan Gem Collection has recently received as a gift from an anonymous donor a very finely carved incense burner made of leek-green aventurine, a massive variety of quartz inclosing minute flakes of mica.

This finely executed example of Chinese carving of the Kien Lung period features dragons combined with designs representing conventionalized clouds. It stands ten and one-half inches high, exclusive of its teakwood base, and was very evidently fashioned from a single block of aventurine, since the lines of color accentuation on the body of the burner extend without break into the removable cover.

Exhibits in Memorial Hall

Several interesting exhibits have been on view in Memorial Hall recently. From April 24th to May 18th, material used by Mr. Lincoln Ellsworth on his recent transantarctic flight from Dundee Island to a forced landing near "Little America" was displayed. The collection included a tent, sledge, supplies, and a model of the plane used. Other exhibits in May included one entitled THE SPRING MIGRATION IS ON, showing specimens of various migratory local birds, fish, reptiles, insects, and bats. An exhibit of various means of communication included an African drum, a picture of a smoke signal, a piece of wampum, birch bark writing, and natural history stamps. Another display that created public interest was arranged in connection with the fifth annual James Arthur Lecture on the Evolution of the Human Brain. This showed sections of the normal human brain and of a brain with tumors. A most timely exhibit was that of the life cycle of the tent caterpillar and of means of controlling this insect.

Geophysical Meeting

At the annual meeting of the American Geophysical Union held in Washington, D. C., April 30th-May 2nd, the Museum was represented by Dr. Robert Cushman Murphy, who took part in the sessions of the section of oceanography. These were presided over by Mr. Columbus O'Donnell Iselin, Commander of the research vessel *Atlantis*. Important aspects of the discussion were concerned with the submarine valleys of the coast shelf and with the new "wake current" theory which has an important bearing upon problems concerned with the Gulf Stream.

Next year it is hoped to plan a meeting of marine biologists on a day contiguous to that of the section of oceanography in order that men of science concerned with these interrelated matters may enjoy the opportunity of exchanging views.

Adult Education

The New York Adult Education Council held a series of three conferences on April 22nd, April 29th, and May 6th on "Current Trends in Adult Education." Mrs. Agnes K. Saunders represented the Museum at these conferences in which representatives from forty other organizations carrying on adult education programs participated. Mrs. Saunders spoke of the Museum's aims, methods, and flexibility, and of the success of adult education programs. Representatives from other museums of the city compared trends and problems in their respective programs. Mrs. Saunders also attended a dinner of the Council on May 4th at which Professor Lyman Bryson of Columbia was the presiding officer.

On April 25th she conducted a round table discussion in a conference on "Art Occupations in Industry" sponsored by the Institute of Women's Professional Relations. College student east of Chicago, educators, and professional men and women were invited to attend the conference. There were fourteen round tables covering broad fields of art such as Advertising, Lighting, and Movie Design. Mrs. Saunders spoke on the scope of natural history work, training required, and opportunities in the field. The conference was held at the American Women's Association and was attended by several hundred persons.

Visits of Crippled Children

During April and May the Museum was host to several hundred crippled children. On April 29th and May 14th some 500 children came from the public schools of New York City, some in wheel chairs and some on crutches, and attended a planetarium showing, were guided through the Museum halls, and saw the motion picture, "Sequoia." On April 16th thirty-two crippled children from Montefiore Hospital spent the day at the Museum, and followed much the same program. These are annual affairs and the enthusiasm and gratitude of the little visitors make their trips a pleasure to the Museum staff.

Credit

Owing to an oversight the Northern Pacific Railway did not receive credit for the use of the Indian pictures in the May issue of NATURAL HISTORY.

The New Books

The Study of Man—Percival Lowell—The Stars—Under the Sea—Gems and Minerals

A HUNDRED YEARS OF ANTHROPOLOGY. *By T. K. Penniman. The Macmillan Co. New York, 1936. 400 pp. $4.50.*

SOCRATES, it is said, first formulated that profound but now hoary dictum: Know thyself. But except for a few tentative gestures in that direction on the part of the fellow countrymen of the sage, man has preferred, until recently, to try to know all about everything *except* himself. Medicine, the only ancient science exclusively absorbed in man, cannot be said to satisfy Socrates' requirement since its development has been largely haunted by the specter of disease and abnormality. Under such pressure it has had little time for the less pressing if more fundamental principles which have shaped man, infused him with wisdom and folly, driven him into social units and governed his behavior.

It has, therefore, remained for anthropology among other newer disciplines to attempt to fill the need for a science of man. Its career has been like Topsy's; it has often had to clothe itself in hand-me-downs; some of its garments inadequately cover its rapidly growing frame; it has disturbingly spacious prospects; in other words it is growing and adapting itself. The history of such a movement should be an absorbing document. But curiously few exist and those few are unsatisfactory. Mr. Penniman has essayed the task and has produced a book which in some respects is by far the best I have seen for the field it covers.

The author has divided the history of anthropology into a formulary period before 1835, a convergent period from 1835 to 1859, a constructive period from 1859 to 1900 and a critical period from 1900 to 1935. The philosophical and social backgrounds which produced the beginnings of anthropology in the formulary period are briefly sketched in. The early anthropological classics of the convergent period are listed and discussed. To the giants of the constructive period tribute is paid, and they are conveniently tagged for the reader. And finally the young and not so young hopefuls of the present are mentioned. Throughout this account the influences of cognate fields on the development of anthropological thought are suggested.

I find the later period divisions rather artifical. The break between the constructive period and the critical is hardly real. I also find myself skeptical that Darwin's publication of *The Origin of the Species* provided as pervasive and as profound a motivation in anthropology as Mr. Penniman seems to believe. Without detracting from Darwin's glorious achievement and his very real influence in anthropology, there are, I think, enough examples in Mr. Penniman's own account to support the belief that much of modern anthropology has roots which go to an earlier period than Darwin. Like the Greeks, Darwin has become the *fons et origo* of historians. We tend to forget that Darwin, great as he was, was part of a movement which he synthesized and expressed more adequately than had been done before. Some of the ideas which he appropriated had in other fields already begun to sprout and produce tender shoots.

I am not erudite enough to know intimately the vast array of names which are marshaled in this book nor all the "firsts" in every field, but I seemed to detect a perhaps pardonable weakness of the author to over-stress the rôle of English anthropologists in the development of anthropology. For example, the impression is given that the English Haldane first enunciated the theory of the Asiatic origin of the B mutation in the blood groups. It is, of course, necessary that the author of a history covering so vast a field exercise some discretion in the selection of the protagonists of his account, but in view of the often lengthy treatment of relatively unknown and as yet insignificant names which are included I wonder why such important figures as Kroeber and Lowie entirely escape mention and why the profound studies of Boas on growth and environment are merely itemized perfunctorily.—H. L. SHAPIRO.

HIGHLIGHTS OF ASTRONOMY. *By Walter Bartky. University of Chicago Press, 1935. $3.00.*

THE AUTHOR, who is Associate Professor of Astronomy in the University of Chicago, has written this book for the astronomical portion of the Introductory General Course in the Physical Sciences, one of the four introductory courses under the new undergraduate curriculum in that institution, the object of these courses being to give the student a general educational background before he ventures to specialize in any particular field.

Doctor Bartky has given hundreds of lectures at the Adler Planetarium, and in the advertisement on the jacket we are told that he has sought to answer in this book some of the hundreds of questions people have asked him in his lectures at the Chicago Planetarium. These lectures together with his years of teaching experience have enabled him to prepare an excellent non-technical text without the introduction of mathematics. The material has been well selected, and treatment is clear and interesting. The author has unusual skill in presenting the results of mathematical investigation without the mathematical calculations.

The modernistic make-up of the book, many of its pages consisting of closely printed matter, with rather narrow margins, its chapter headings in small block letters, all tend to make the volume, according to this reviewer, somewhat formidable, which character is not deserved by the content. It is relieved, and made much more attractive, however, by many drawings by Chichi Lasley and by many astronomical photographs from the Yerkes Observatory.

Packed in 280 pages is a good working knowledge of astronomy, certainly a treatment adequate enough to enable any beginner to determine whether his natural bent would impel him to go further into the subject.

As an adjunct of the book, the author has devised an instrument, which he calls the "Stellarscope," for the study of the night sky. Through this ingenious and unique device, the stars and constellations are viewed on motion-picture film, illuminated and magnified. Each tiny sky-map, of which there are 24, is named on the film. By superimposing each individual film upon that portion of the sky, the exact identification of the heavenly bodies is made simple and easy. The "Stellarscope" is also distributed by the University of Chicago Press at the price of $2.00.—CLYDE FISHER.

AUTOBIOGRAPHY OF PERCIVAL LOWELL. *By A. Lawrence Lowell. The Macmillan Co., New York. $3.00.*

The reviewer is not certain whether he should compliment the author for making his late brother tell his own story, or congratulate him on cleverly combining the narrative of Percival's life with the results of the Lowell Observatory's work on the planets.

The book is really in two distinct parts. One deals with the early life and travels of this remarkable person, who was gentleman, diplomat, correspondent, author, lecturer, business man, and mystic. The other describes the growth of a passion for astronomy that gave a new unity to his life, and culminated in the building, maintaining, and endowing of a great observatory.

From his graduation from college until he was 38 years old Percival Lowell traveled through Japan and Korea. He loved the East. He lived there as a native, and with a sympathy rare in an Occidental brought the East to the West by his delightful and inimitable pen.

As one reads the biography he sees that this was merely a period of preparation for the work Lowell was to do later. As a child he used a small telescope and read astronomical books. In college he had an excellent groundwork in science and mathematics.

Then came the sudden intention to devote himself to the sky. He organized and built his observatory. He realized that like an institution of learning an observatory is not merely a building, but involves a competent and sympathetic staff as well. Both these elements were combined and are there today in Flagstaff, Arizona as a result of the vision and ability of Percival Lowell.

The remaining half of the book quotes at length from the writings of this "amateur astronomer" and from the Annals of the Observatory. It describes the intensive work on Mars and recounts the growing conviction of Lowell that Mars is inhabited by intelligent beings. This, as some may think, was not a preconceived thesis to be proved, but a conviction arrived at only after much observation. The reviewer, like the author, cannot improve on Lowell's own words:

"To review, now, the chain of reasoning by which we have been led to regard it probable that upon the surface of Mars we see the effects of local intelligence. We find, in the first place, that the broad physical conditions of the planet are not antagonistic to some form of life; secondly, that there is an apparent dearth of water upon the planet's surface, and therefore, if beings of sufficient intelligence inhabited it, they would have to resort to irrigation to support life; thirdly, that there turns out to be a network of markings covering the disc precisely counterparting what a system of irrigation would look like; and, lastly, that there is a set of spots placed where we should expect to find the lands thus artificially fertilized, and behaving as such constructed oases should. All this, of course, may be a set of coincidences, signifying nothing; but the probability points the other way."

Next comes a period of study of the solar system and its origin; the evolution of the planets; studies in celestial mechanics on the asteroids; the rings of Saturn; and finally the prediction of a planet beyond Neptune. Even if it were a mere coincidence (which it probably was not), the finding of Pluto in 1930, fourteen years after Percival Lowell's death, completed his unfinished work. It is fitting that it should have been found at *his* observatory—and fitting that its symbol ♇ should stand not only for Pluto, but for Percival Lowell.

—WM. H. BARTON, JR.

THE STORY OF THE GEMS. *By Herbert P. Whitlock. Lee Furman, New York. $3.00.*

Scheduled for publication in June, 1936.
To be reviewed later.

THE BOOK OF MINERALS. *By Alfred C. Hawkins. John Wiley & Sons, New York. 161 pages; $1.50.*

THIS little book is not "just another Mineralogy text book"; its appeal is wider and more universal than even the university. It fits into the pocket of Boy or Girl Scouts as well as it does into that niche in their brains that is reserved for things scientific. Those of us who are privileged to come into contact with the sons and daughters of the "man in the street" know that there has been a very considerable awakening of interest in minerals during the last decade. Doctor Hawkins' book does much to stimulate that interest; its lucid diction and well chosen half-tone illustrations appeal to the novice mineral collector, no less than does its moderate price.—H. P. W.

TWENTY YEARS UNDER THE SEA. *By J. E. Williamson. Hale, Cushman and Flint, Boston. 320 pages, 55 photographs. $2.50.*

FOR TWENTY YEARS J. E. Williamson has been photographing sea-bottoms, staring at octopuses, sharks, and Hollywood mermaids through the glass window of his "photosphere." This "photosphere" is a refinement worked out by Williamson on a deep-sea salvaging device invented by his father. The perfected apparatus is a four-ton metal sphere with great glass windows, hanging at the end of a flexible metal tube.

In 1913 Williamson was "photographer, artist, and often reporter to boot," on a Norfolk newspaper, the *Virginian Pilot.* In the traditional manner of young newspaper men he harbored the hope of coming "upon the one big story that will surpass all other adventures." When he conceived the notion of modifying his father's invention, he forgot all his regular assignments. His mind was "crowded with the visionary scheme of taking pictures beneath the sea."

When he brought the first successful undersea photographs ever taken back to the office of the *Pilot* (which prepared a full-page Sunday spread) Williamson was already excited over the possibility of making moving pictures under water. The rest of his book is largely given up to accounts of his exploits in making submarine moving pictures and in collecting specimens for scientific institutions.

Williamson has gotten many fearsome and beautiful effects into his undersea pictures, such as the funeral cortège in *Twenty Thousand Leagues Under the Sea.* For the struggle between the octopus and the pearl diver in this picture he constructed a most ingenious cephalopod, with a diver sitting in its head, and with its fifteen-foot tentacles writhing under the pressure of compressed air. As might be expected this octopus showed none of the timidity which makes the real octopus a rather disappointing actor; and most of the spectators were as satisfied as the newspaper critic who affirmed that "there can be no question of fake or deception."

Mr. Williamson, among other adventures, has killed his shark, diving beneath it with a knife, in the good old Bahama fashion, but the most alarming experience he had was when he felt an anomalous shape crawling within his helmet. When he finally was drawn up to the surface he found that a scorpion had secreted itself in the helmet.

The photographs include magnificent coral groves, gaily striped tropical fish, fantastic scenes from under-water motion pictures and an abundance of sharks.

While Mr. Williamson makes no pretense of being a scientific observer, and is certainly over-generous in the use of expressions like "man-eater" and "monster," his book is continually entertaining, and sometimes exciting.—G. L.

A WORLD OF CHANCE. *By Edward Gleason Spaulding. The Macmillan Co., New York. $3.00.*

THIS book is an argument for a thorough-going Indeterministic position as regards the Structure of Reality, to include in the meaning of this term not only Nature, but also that realm of fact which is not part of Nature, but of which, conversely, Nature itself is an instance." To his own questions Whence, Whither, and Why, Professor Spaulding finds the answers From no Source, To no End, and For no Reason. He considers that this is a Pluralistic universe and that the World, in the broadest sense, is a world not of necessity, but of chance.

Recent Museum Publications

NOVITATES

No. 837. A Classification and Phylogeny of the Elasmobranch Fishes. By E. Grace White.

No. 838. The Heart Valves of the Elasmobranch Fishes. By E. Grace White.

No. 839. *Pagothenia,* a New Antarctic Fish. By J. T. Nichols and F. R. LaMonte.

No. 840. African Bees of the Genus *Allodapula.* By T. D. A. Cockerell.

No. 841. Records of North American Gnaphosidae with Descriptions of New Species. By Ralph V. Chamberlin.

No. 842. The Australian Ant Genus *Froggattela.* By William Morton Wheeler.

No. 843. African and American Oligochaeta in the American Museum of Natural History. By W. Michaelsen.

No. 844. Western Bees of the Genus *Cerathina,* Subgenus *Zaodontomerus.* By Charles D. Michener.

No. 845. A New Genus and Species of Fulgorid from Haiti (Homoptera: Fulgoridae). By Herbert L. Dozier.

No. 846. Results of the Archbold Expeditions. No. 9. A New Race of *Hyosciurus.* By G. H. H. Tate and Richard Archbold.

No. 847. African Hylaeine Bees. By T. D. A. Cockerell.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Honorary Life Members

Mrs. Antoinette K. Gordon.
Lieut. Col. F. M. Bailey.
Major James Corbett.

Life Members

Mrs. Conrad P. Hatheway.
Mr. Edward K. Warren.

Sustaining Members

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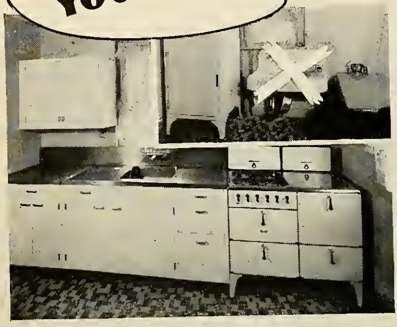

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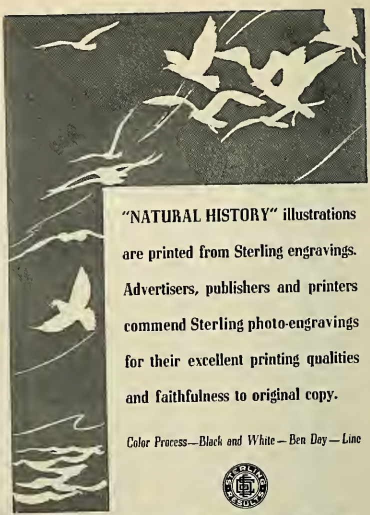

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CLASS E MILE MARK BOOSTED TO 52 M.P.H.

225 Cu. In. Gray Engine Developing 200 H.P. Drives "Prigg Fireball" Through ⅞" Monel Metal Shaft to New World's Record

By A. P. MORE
The International Nickel Company, Inc.
67 Wall Street, New York

Over a one mile straightaway course at Indian Creek, Miami Beach, Florida, last March 23, Paul Prigg drove his new 225 cubic inch class "Fireball" to a new world's record for Class E runabouts of 52.027 miles per hour. The new mark, 4 m.p.h. faster than the previous record, was set in choppy water with a strong cross wind.

Beset by shafting difficulties in previous attempts, Prigg, driver and builder of the racer, installed a ⅞" Monel Metal propeller shaft for this final record trial. After his gruelling race against time Prigg said: "Before installing a Monel Metal shaft, we twisted off two shafts and had considerable trouble also, in keeping them straight. After installing the Monel shaft, we had a smooth running drive and no indication of twisting off.

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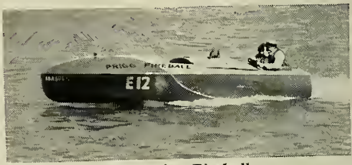

The Prigg Fireball

This driving of champions is nothing new for Monel Metal. Two Monel shafts drove Gar Wood and his Miss America to a world record. The perennial lizard, El Lagarto, three time winner of the Gold Cup, has always been driven by Monel Metal.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-seventh Street and Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

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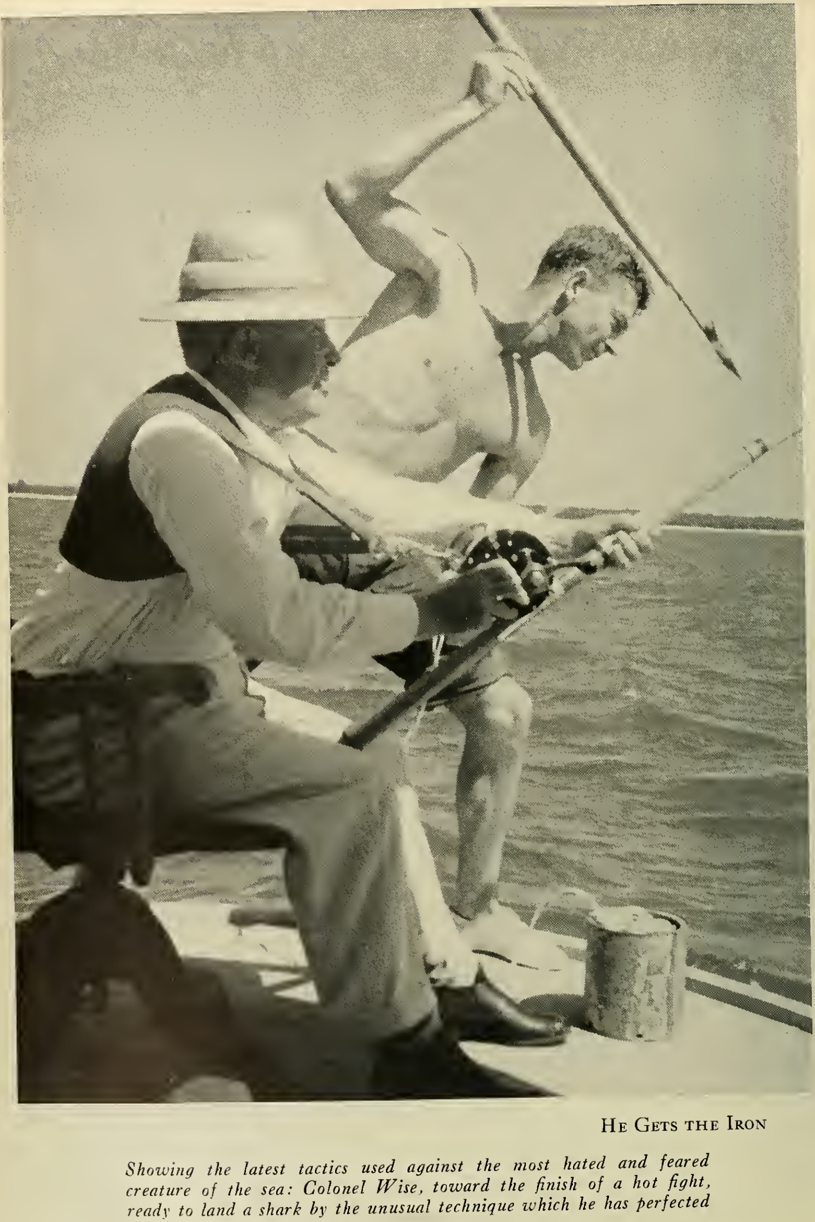

He Gets the Iron

Showing the latest tactics used against the most hated and feared creature of the sea: Colonel Wise, toward the finish of a hot fight, ready to land a shark by the unusual technique which he has perfected

Tigers of the Sea

The truth about sharks, told by a man who has devoted years to outwitting them. The first of a series of three articles

By COLONEL HUGH D. WISE
U. S. Army, Retired

A COMPENSATION for hardships and uncertainties of active Army Life is the opportunity it affords for sport with rod and gun in many parts of the world. I have taken full advantage of this but omit here discussion of all but shark-fishing which I have pursued at home, in Cuba, in the Philippines, in Hawaii and in the Bahamas.

My first exciting experience with the shark was as a youngster in my early teens. I used to go out on Matompkin Inlet, on the Atlantic side of the Eastern Shore of Virginia, with a crew of market fishermen. Those were wonderful days, when glorious fishing always ended in a sailing race between the fishing boats up Folly Creek to Drummondtown, each boat trying to be first to market.

Taken for a ride

One day, boy-like, I had gotten into the dory swinging astern of the "bateau" "Lottie Garrison" and was fishing there when a big Hammerhead whizzed past, turned and began slowly circling the boats. From my pocket I took a large hook which I had treasured there for weeks, tied it onto the end of the painter of the dory which was simply looped over a cleat on the "bateau." I baited it with a weakfish and cast out. As it floated on the surface fifty feet away, the Hammerhead on his next turn took it with a gulp—"Snap!"—The painter tightened and the dory's bow went almost underwater, bobbing up and down, while its stern skidded crazily from side to side. I managed to whip the loop free from the "bateau," scrambled over the thwarts to the stern of the dory, and got an oar into the sculling groove. So, holding the dory head-on, I was taken for a ride at speed hitherto never experienced by me in a small boat, for motors had not then been invented.

"Where the—do you think you're going?" shouted Captain Billy Milner, as I scudded past. This was really a useless question, for no one could have had less idea than I had of where I was going. I was on my way, however, and I was going fast.

In chase

I seem still to hear the unparliamentary remarks shouted after me by that salty crew whose fishing I was spoiling at the very best of the tide, for Captain Billy, who felt some responsibility for me, had ordered fishing lines in and sails up. Overboard went his cable and he was after us, but we had a half-mile start before the "bateau," leaning to the breeze, was under headway.

In a mile or so they had nearly overhauled us but my tug then suddenly changed its mind and we shot off to windward, giving our pursuers a two-mile beat of it before Captain Billy grabbed the dory's stern with a boathook and his crew dropped sails. Then shark, dory and "bateau" moved in procession at a somewhat slower speed until strong arms hauled in the offending shark and murdered him. By this time the crew, in the excitement of the chase, was no longer murderous in its intentions toward me and I was thrilling with delight at the sport I had given them, quite unpenitent of having spoiled their morning's catch. On the contrary, I think I was proud of having provided such an incident. From that time on I have been a confirmed shark-fisher, but was too closely watched by Billy ever again to play that game when out with him.

This shark had every temptation to attack the little dory, but he did not do it, nor since then, under similar circumstances, have I seen one do it. A lameness which I brought home with me from the World War put an end to my hunting and to my fishing on foot, but there had to be outlet for the sporting instinct developed in me by a life of service in the army with hunting and fishing around the world. Bass-fishing and blue-fishing were still practicable and I enjoyed them but, in Hawaii and the East, I had had a taste, a good big taste, of angling for heavy sea fish and this had somewhat marred my zest for pursuit of smaller varieties. Pegging away to find what I could do, I soon learned that though my stream-wading days were done, I could still be "hell in the swivel chair!"

For many years I had had fun fishing in various ways for sharks, but now I took to angling for them with rod and reel at times when I could not reach other big fish and, in so doing, I developed for myself the somewhat unique or at least unusual game which I shall describe later.

Glamourous combat

There is a glamour to this fishing which comes with no other angling. I have tried to analyze its fascination, which seems really to be the zest of combat with the "Tiger of the Sea," for whom there is no feeling of pity to mar the exultation of victory. Even for the swordfish, which may be as big and as strong as most sharks, one feels a regret when he is killed; but, for the shark, there is no compassion—he is a pariah. When he is brought up, his glaring amber eyes evoke no feeling of kindliness and his snapping jaws, with dreadful dagger teeth, convey only the impression that he is an armed enemy who would give no quarter and who is entitled to none. From the moment when he takes the hook, his capture is a fight—a fight which excites the lust to kill a predatory creature whose life is a menace to all other denizens of the sea, and whose death will make the angler their protector.

A question sure to be asked when sharks are mentioned is: "Do sharks attack and kill men?" Whatever be the reply, there is likely to be a dispute, because the question, in such simple form, cannot be definitely and authoritatively answered.

Sharks do not go forth to stalk men as cats do mice nor to catch them as wolves do deer. Fish are the regular victims of even the most predatory sharks, and man, though probably an acceptable morsel, would be a most unexpected addition to their menus. Nevertheless, sharks do occasionally get him.

We can only guess at how much truth there may be in the yarns we hear of shark attacks, but there must be a more solid foundation than superstition and imagination for the general and real fear of sharks shared by practically all watermen, though few of them can cite cases of shark attacks within their own personal knowledge.

Killings

There are countless instances of the eating of dead men by sharks, and there are many reports of their attacks upon live men. Both our War Department and our Navy Department officially report several such killings. Governor Pinchot tells of one such in Tahiti, and Captain William Young has collected in his book some authentic reports. Nevertheless, I have repeatedly seen soldiers from transports, in shark-infested waters, swimming unharmed about the ship and thousands of tourists watch natives diving for pennies at tropical ports, where harbors are teeming with sharks, without ever seeing a diver harmed by one.

Probably the most dangerous species in our North Atlantic are the Great White Shark, the Great Blue Shark, and the Tiger Shark, none of which is really common in our waters, but it seems to be a generally accepted fact that sharks are more dangerous in the tropics where, incidentally, these species are common.

To get facts in this much contended question of shark attacks on man, Mr. Herman Oelrichs, some years ago, offered, through New York papers, a reward of five hundred dollars for authentic information of such an attack in our waters, but the reward was never claimed. Similar rewards were later offered, and a number of papers took up the discussion which brought to light no credible instance in our zone though there were a number in tropic waters.[1]

The late Dr. F. A. Lucas, of the American Museum of Natural History, quite thoroughly investigated this subject and he believed that the danger of being attacked by a shark in the vicinity of New York is "infinitely less than that of being struck by lightning." Nevertheless, periodic shark scares persist, and in one of these, in 1932, newspapers published alarming casualties on our bathing beaches. Some resorts even safeguarded swimmers by wire fences in the surf and the barbs of these were probably more dangerous to the bathers than were the teeth of sharks.

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[1] Brooklyn Museum Bulletin, Vol. 3, No. 1.

At the height of this excitement Mr. C. M. Breder, Jr., of the New York Aquarium, made a trip to study conditions in local waters, but found sharks no more numerous nor ferocious than usual and he concluded that most of the panic was probably due to publicity and exaggeration and that at that time there was not an authentic case of attack by sharks in our region. It is quite necessary to realize that there is a difference between shark bite and shark attack and that lack of caution may, and often does, result in severe laceration from the teeth or in a terrific wallop from the tail of a frightened or wounded shark.

Danger zones

In some parts of the world sharks are much more dangerous than they are with us and Dr. C. H. Townsend, Director of the New York Aquarium, has furnished an article* which should remove all skepticism as to whether sharks will attack men. He cites numerous instances in which men were attacked and devoured and tells of cases where not only were swimming men seized but also where sharks grabbed the oars or outriggers of boats.

In Polynesia, the almost amphibious natives regard the shark with a dread akin to that of the African for the lion, though the shark takes less toll in human life because he cannot stalk his prey, as does the lion, on land.

In Australia, the shark is a greater danger than he is with us. Especially is he a menace in Sydney Harbor where his predatory habits have doubtless been encouraged by the custom of disposing of slaughter-house refuse in the bay and so chumming up the sharks.

In the Solomon Islands, sharks are singularly bold and ferocious, which may be accounted for by the custom of disposing of the dead by throwing their bodies into the sea—thus literally training the sharks to eat men.

Interesting conclusions of Doctor Townsend are that sharks of tropical waters are more ferocious than those of temperate zones, that sharks are more dangerous at night than in day, and that the most dangerous time is dusk. Also he believes that large sharks are not necessarily more dangerous than those not so large and that all sharks are particularly dangerous when swarming on feeding grounds.

This all seems to confirm my own belief that, while sharks do not set out on man-hunts, they will, under favorable circumstances, attack man, especially if impelled by hunger, excitement or the blood-scent, and that they are particularly dangerous when in feeding swarms.

It is going a little strong to say, as recently did one scientist, that a shark will not attack man unless he gets the blood-scent for, though that unquestionably excites him, there are many authentic cases where he has attacked without it. Nevertheless, it is my opinion that a shark, except when surprised, attacked, or greatly excited, rarely attacks a man whom he does not believe to be dead or helpless; and I believe that, except in self-defense, a shark prefers to avoid anything which might fight back. It is prudent, however, not to risk being the victim in an exceptional case. Since the angler, if he accepts my advice, will try to stay in his fair-sized motor boat, the man-eating tendencies of sharks are not of immediate importance, nor is it here necessary to convict or acquit the shark of anthropophagy. Suffice it to say that I do not recommend him as playmate at a bathing beach.

A bad moment

On one occasion in the Philippines I was shark-fishing from a canoe. A big Tiburone was towing us around, when he suddenly turned and rushed head-on against the boat. His impact threw the two paddlers and me into the bottom of the boat and, as I wallowed there, I had a distinct sense of relief when I felt the rope tauten as the shark, having swung away, took up the slack. This might make a fine story of a shark attack, but I am afraid that I will have to admit that the shark had no intention of attacking that boat but simply collided with it in his frantic efforts to escape.

This large, ubiquitous and abundant fish which, except to a few sportsmen, has for centuries been but a nuisance, has recently become of economic value, and commercial companies are now engaging in shark-fishing as a profitable enterprise. Their catches taken in large specially constructed nets, are measured by tons and practically all of this weight of fish is utilized. Formerly, shark hide or "shagreen" was used mainly as an abrasive, like sandpaper, and it was of great service for cleaning decks. Its non-slippery quality made it useful for sword hilts and tool handles and its durability for bags and pocketbooks; only recently a process of tanning was discovered which effectively and economically removes the denticles of the skin, and thus converts the hide into a beautiful leather of superior toughness and durability, called "galuchat."

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*Bulletin 34, N. Y. Zool. Society, Vol. XXXIV. No. 6, 1931.

The liver of a shark may be a fourth or a fifth of his weight and oil from the liver, about four gallons from a six-footer, is used in tempering steel, in paint, and in many other commercial ways. Medicinally, it has been found to possess vitamins which make it a rival of cod liver oil.

Shark as food

Dried fins, used for the famous shark-fin soup, bring good prices wherever there is a Chinese population, and quantities of them are exported to China.

Certain varieties of shark whose flesh is especially fine of texture and delicate of flavor, are marketed as "steak fish" and "grey fish," others are salted and packed, while plugs punched from shark steaks and ray fins and doped with clam juice, become "deep sea scallops." The less desirable flesh is dried and ground into poultry meal and the remainder is reduced to fertilizer.

The prejudice against eating shark meat seems largely due to the idea that sharks are scavengers as, in fact, some of them are, though no more than most other fishes and crustaceans, especially crabs and lobsters; and I know of at least one famous trout pool which is close to a sewer outlet. Many people enjoy shark meat without suspecting what they are eating.

Once, while watching my boatman skin and trim a two hundred pounder, I asked, "What are you going to do with that shark?"

Grinning, he replied, "This was shark—now it is just fish—tomorrow, in the market, it will be swordfish."

A serious charge against the shark and one which can be sustained, is the great damage he does to fish-traps and nets, and the tremendous toll he takes of fish which men want for themselves. This indictment of the shark may serve to salve the conscience of the sportsman who goes forth to assassinate him. Certainly it will make easier the getting of bait because seinemen are ever ready to contribute trash fish for a fight against their arch-enemy.

One of the sea's leviathans

The shark belongs to one of the largest and commonest orders of fishes of the present times and is also one of the oldest living vertebrates. He has come down from past geological ages little changed except in size, for, big though he now is, he was larger then, fossil remains showing that he may have been over a hundred feet in length.

One almost needs logarithms to calculate the weight of such a fish but, since his length, exclusive of caudal fin, would be about 974 inches and his girth about 450 inches, his weight, by a rather reliable formula, would be:

$$\frac{450^2 \times 974}{800} = 246{,}543 \text{ lbs. — or about 123 tons}$$

Such conjectures aside, there is in the American Museum of Natural History the reconstructed jaw of one of the leviathans which swam the seas when glaciers covered the northern part of our continent. The fossil teeth of the *Carcharodon*, averaging 4¼ inches in length, found in the Tertiary deposits of North Carolina, are set in a jaw modelled after the jaw of the White Shark, his nearest living relative. This jaw would easily take in a four-poster bed and, from the estimated length of the fish, we can calculate his weight as over thirty-eight tons.

It is remarkable how little is known of the habits and characteristics of this oldest and largest of our common fishes. Even Garman, the recognized authority on shark taxonomy, barely touches upon this subject. Sharks have swum the waters of our globe for more than three hundred million years but much about them still remains a mystery. Let a man embark upon an investigation of them and he will soon find himself engulfed in such a welter of scientific fact, unsubstantiated legend, imaginative folk-lore and plain garden variety of fish story, that he is hopelessly swamped. He will probably conclude that he is dealing with "all kinds of a fish" as, in fact, he is, for the order, Plagiostomia, includes the huge Manta and the little Skate, the great Whale Shark and the small Dogfish, the vicious White Shark and the cowardly Nurse. There are among the sharks deep-sea flesh-eaters and shoal water mollusk-feeders. They are found beneath Arctic ice and on tropic coral reefs. They cruise mid-ocean and haunt the waters of coastal marshes, but, wherever sharks may be, they are undisputed masters, and upon their slithering approach all other denizens fin away. Whether harmless to man or a menace to him they are hideous and they are hated.

Face inspires dread

There may be justification for this hatred of the savage predatory shark and for the descriptive "hideous," usually applied to him, but in fact it is only his face, with leering sinister eyes and dreadful spiked teeth, which makes him hideous, otherwise his graceful form and delicate shade would make him beautiful. No creature of the sea is so gracefully lithe as the shark, silently gliding through the water, but none is so terribly fearsome as he when he dashes at his prey.

In his physical structure, the shark is highly specialized to meet conditions under which he exists, while, as a vital organism, he presents some features which are almost unique. Conspicuous among these are his spiral valvular digestive tract and his dual organ of reproduction. For a fish, he has a well developed brain, his sense of smell is acute and his hearing is supplemented by nerves, which are extremely sensitive to vibration.

There is no air-bladder, as there is in most fishes, so the shark, deprived of this means of changing his specific gravity, must regulate his depth by muscular effort, in other words, by swimming; he is therefore rarely seen quiescent.

In nearly all species of true sharks, a long, lithe, muscular, fusiform body tapers from its largest part, about a third of its length back of the nose, forward into a pointed conical head and aft into a long, round, graceful tail or peduncle, which terminates in a large swallow-tailed caudal fin, or fluke.

Different from the swimming of most fishes and characteristic of that of the shark are the sinuous undulations of his body by which he supplements caudal-fin propulsion and this gives to him a peculiar slithering, ghost-like glide. His litheness is in large part due to the absence from his body of stiff bones, for his frame is mainly of heavy cartilage; his only fossil remains are the enameled-covered teeth.

Over his cartilaginous framework is stretched his truly marvelous muscular system covered by a denticled hide, so tough and so protected by small, close-set, horny scales as to defy all but sharp, well tempered instruments and almost to justify the saying that "only a shark can bite a shark."

The first dorsal fin, usually large and erect, is much larger than the second dorsal, the anal and the ventrals. Pectorals are usually long and sickle-shape. The size, shape, and position of all of these fins vary with different species and are to be noted as important clues to identification. Only the caudal fin, which is also important for identification, is important in propulsion; other fins being used mainly for balancing and guiding.

Near the ventral fins, in male sharks, are found the "claspers," which might be mistaken for fins but which, in fact, are sexual organs.

Gill-openings are usually five (in some species, seven) parallel vertical slits which are not covered as in other fishes, and the spacing of these slits is another clue for species identification.

Teeth

The mouth, situated beneath the head, the nose projecting well beyond it, gives to the shark the familiar, disagreeable "overshot" expression. The mouth is of enormous size and is sometimes supplied with as many as seven visible, parallel, curved rows of teeth. Only the front two or three of these rows are functional, those in the rear being in successive stages of development and inclination backward while still more rows have not made their appearance. The teeth are not set in the bone of the jaw but grow from the hardened skin of the mouth. As this skin grows forward the teeth develop and rise to vertical position and the rows are successively shed over the front edge of the mouth. The fish is thus constantly provided with new dentition and this explains why so many shark teeth are found on the shore and why fossil teeth are so abundant.

The difference between teeth of species is a valuable means of identification as well as evidence of the habits of sharks of each species.

Most sharks either bite and swallow their food down large gullets, as do the White, the Blue and the Mackerel, or they crush it as do mollusk-eaters, like the Nurse and the Dogfish—none of them chew and masticate. Some species, notably the great Whale Shark*, feed on small fishes, jelly fishes, small crustaceans and algae which pass down their small throats after being strained from huge volumes of water by their gill-brushes. For obvious reasons, their teeth are small, and one family, the Basker, substitutes for teeth a brush-like apparatus which serves as a sieve.

Even in the group which we may call "biting swallowers" there are different tooth shapes for the different species and this helps distinguish them. The Mackerel Shark has long pointed teeth, the White has broadly triangular ones; the Hammerhead combines these puncturing and cutting qualities in his narrow triangular teeth and the Tiger Shark's teeth are large, broad and sickle-shaped. The broad and rather flat teeth of mollusk-feeders are set like paving tiles and sometimes are practically jointed together.

Fast swimming species feed usually on live fish which they pursue and capture, but slower ones may have to content themselves with mollusks, crustaceans or even with offal. In general, however, the shark is not a carrion feeder.

One objective—food

With their equipment for offense and dedense, sharks have naught to fear in the sea where no other fish will attack them, where their only danger is from other sharks, where their whole existence is but a continuous search for food to satisfy insatiable appetite. The shark is always hungry—he suffers from incurable belly-ache. Be it live fish, dead fish, flesh or fowl, all is grist for the shark's mill and he is always on a predatory prowl after it. Never does he seem to rest. His big fins appear above the surface, or beneath it he slithers in from nowhere, but he is always headed for the same objective—food.

What may be the span of the natural life of a shark is yet undetermined for he has no scales, whose rings might tell his age, and his teeth are but temporary equipment. It is doubtful, however, whether many sharks live out their natural lives for, if ever they lose, even temporarily, the capacity to defend themselves, other sharks are quick to kill and eat them.

Sharks are the most cannibalistic of cannibals and in large ones are often found smaller ones which have been devoured. Dr. E. W. Gudger, of the American Museum of Natural History, has published a most thorough and instructive paper on shark cannibalism, in which he shows that practically all sharks prey upon other sharks as well as upon their cousins, the skates and rays.*

Powers of digestion

I once saw taken from the stomach of an eight-foot shark, a three-footer which had been swallowed whole. To appreciate that gastronomic accomplishment, one must remember not only the size of the morsel but also the sharp teeth, the hard stiff fins, capable of cutting a heavy line, and the tough denticled hide which defies ordinary tanning processes. One wonders at gastric juices which can digest such things as are taken from the stomachs of sharks; for example, a horse's hoof with the iron shoe on it—the bones had been completely dissolved, the horn casing was softened to the consistency of leather and the iron was being rapidly corroded. Could doctors use shark juice instead of pig juice to get pepsin? In this digestive fluid there is a very high content of hydrochloric acid, and I have seen it remove the varnish when spilled on a deck.

Nevertheless, we read in Darwin's *Voyage of the Beagle*—"I have heard from Doctor Allan, of Forres, that he has frequently found a Diodon†, floating alive and distended in the stomach of a shark; and that on several occasions he has known it to eat its way, not only through the coats of the stomach, but through the sides of the monster, which has thus been killed. Who would ever have imagined that a little soft fish could have destroyed the great savage shark?"—Who would imagine it? We must say, like Charles Dana, "Important if true," but we may conjecture at least that the Diodon had an uncomfortable swim.

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*Dr. E. W. Gudger has written on the Whale Shark in the following numbers of NATURAL HISTORY: January-February, 1923, p. 62; March-April, 1930, p. 182; September, 1935, p. 128; and February, 1936, p. 159; in Bulletin of the American Museum of Natural History, 1935; and in Novitates No. 318, 1928.

*Gudger, E. W.—"Cannibalism among Sharks and Rays," *Scientific Monthly*, May, 1932.

†A species of puffer fish.

It is not uncommon for sharks to attack another shark when he is held on a line and to bite great chunks out of him and it is still more common to find sharks which have been partially devoured while they were enmeshed in nets. Apparently, they live in armed neutrality, but when one of them becomes disabled or helpless his comrades give him short shrift.

Speaking of the slashing of one shark by another brings to mind the old superstition that a shark must turn on his back or side to bite. To one who has watched sharks take the bait and who has seen them bite one another, this is, of course, utter nonsense. A shark's eyes are not well placed for forward-downward vision, so he may have to roll for better view; and, frequently, the roll is but the preliminary of his dash at an object.

Another foolish idea is that female sharks swallow their young to protect them, disgorging them when captured. The fact is that, on capture, viviparous females often give birth to their young and, incidentally, it may surprise you to see how self-reliantly the pups swim away when tossed overboard.

An arrant coward

Contrary to popular idea, the shark is wary, almost timid, for monster though he is, he is averse to taking chances. He is however, possessed of a curiosity which sometimes urges him on and makes him appear bold when, in fact, he is terrified; but at heart, if his heart be aught but a blood-pump, he is an arrant coward.

Nothing could better illustrate the curiosity and the timidity of sharks than an incident related in Captain Young's book. A diver working with him in Hawaii was constantly surrounded by curious sharks which, however, did not molest him; but, when they nosed up uncomfortably close, the diver released some air bubbles from his wrist-band and this sent them gliding away.

Even a large shark, with a large skull, has but a handful of brain-matter for the brain-cavity is only partly filled. Nevertheless, this handful seems to provide him with a disproportionate amount of suspicion and with perception enough to beware of a bait tied onto a string. I have seen sharks rush furiously up to a bait then stop, draw back and examine it, but they would instantly seize and gobble an identical free bait floated out to them.

Usually a shark does not take the bait with a rush but will first seize it in his teeth before swallowing it. When, however, he has decided, he takes it with a gulp.

Blood lust

However hesitant sharks may ordinarily be, all hesitation leaves them with the smell of fresh blood, which puts them into a frenzy. Testing this one day when several sharks were cautiously nosing at my bait, I poured over the boatside some blood from a recently captured shark. Instantly one of the investigators seized the bait and the others went frantic. Taking advantage of this characteristic, I have always since then bled newly caught sharks over the gunwale, usually with good results.

Under skin-flaps in the anterior portion of a shark's head are two large nostrils and as his olfactory organs are excellent, his sense of smell is acute. He gets the blood-scent at amazing distances and rushes toward it. Literally, it seems to make him see red.

For this reason, blood is good chum and there is no better chum than the warm rich blood of the porpoise, though any blood, from fish, fowl or animal, will attract sharks.

When not excited by the blood-scent, sharks are surprisingly wary and alert. As they circle the boat, their unblinking yellow eyes are ever on watch, and their sensitive nerves are always atune. A wave of the hand or a sudden noise sends them gliding away, to return, probably, when impelled by irresistible curiosity or insatiable appetite.

By "noise," I mean vibration or jar in the water, for I have observed that they do not seem to be afraid of other noises, such as loud talking, for example. To try this out, I have even shouted at sharks swimming close to the boat without alarming them in the least, but a bang on the boat-bottom sent them dashing away. Nevertheless, for some unknown reason, talking seems to make them timid about taking the bait.

Most sharks are very moderately gregarious but, where one is found, there will probably be others, temporarily together, because their individual searches have led them to that place on the trail of food. When their maws are filled, or when the possibilities of the locality are exhausted, they will leave to resume their ceaseless prowls in search of more food.

In most sharks there is little instinct to school, like the bluefish for example, though some of the smaller species do at times swarm, and Nurse Sharks and certain Sand Sharks assemble in great numbers in shallow water at breeding season.

No admirable traits

Being masters of the sea, sharks need not join for defense; community of interest does not exist in their selfish, individualistic natures, and, in their lives, every fish is for himself. Most animals and many fishes unite against common foes but sharks do not, unless there be prospect of a feast after the battle.

Even a ewe will fight for her offspring, but I have never heard of such action by a female shark. When her pups are born she is done with them.

In the study of animals, or even of fishes, a man usually finds something likable about them, but in the monstrous, cruel, cowardly shark he can find not one admirable trait—he is simply a tiger.

The white fishermen of the "Eastern Shore" detest sharks because of the loss they suffer from them, but, to this detestation, the colored population add a superstitious dread. Of the colored men about my father's place, Silas, alone, was ever ready to go fishing with me and I always wanted him because he saved me the labor of stepping masts and hoisting anchor. One day we took with us Tom, a young man who affected to share the contempt which Silas had for sharks, and who kept repeating Silas' slogan: "Dey kaint hurt yer in de boat."

We were soon hung onto a big shark which they were hauling in while I, at the tiller, maneuvered the skiff to give them slack. In the process of these operations, the shark swished the rope across the stern, and, catching Tom's leg, threw him overboard. He could swim, and all he had to do was to get hold of the rope and haul aboard by it but the idea of a shark at the other end of that rope, fifty yards away, was so horrible that Tom was deprived of reason and, his eyes rolling white while the tide took him back, he simply howled: "Bring dat boat! Oh Lord, get dat shark outen here! Oh Lord, take dat shark away!"

When we finally hauled Tom (and the shark) aboard, Tom was given the honor of being allowed to bash in the shark's head with a hatchet. At the first wallop, the shark opened and snapped his jaws.

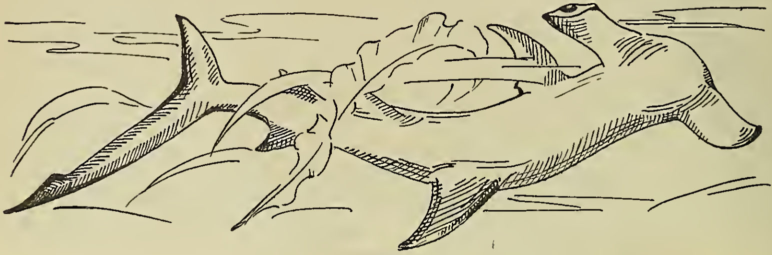
"Shut yer mouf, Shark!" yelled Tom, with another wallop, "I'se seed all I wants ter see of dem teeths—an' I'se done felt 'em too—tearin' through my gizzard when I was back thar in de water wid yer!"

The shark's tenacity of life is amazing. He seems to be immune to nervous shock, cruel wounds affect him only slightly, and he remains dangerous a long time out of water. I have seen a shark, whose liver had been removed for chum, swim strongly away and I once saw a boatman knocked over the gunwale by a shark which had been in the boat nearly an hour.

In the next month's NATURAL HISTORY *Colonel Wise will narrate a number of exciting encounters he has had with sharks off the eastern coast of the United States while perfecting the rod-and-reel methods of which he is chiefly the originator.*

HAMMERHEAD SHARK

Drawn by Else Bostelmann



Tigers of the Sea

(Photograph by James Thompson from Globe)

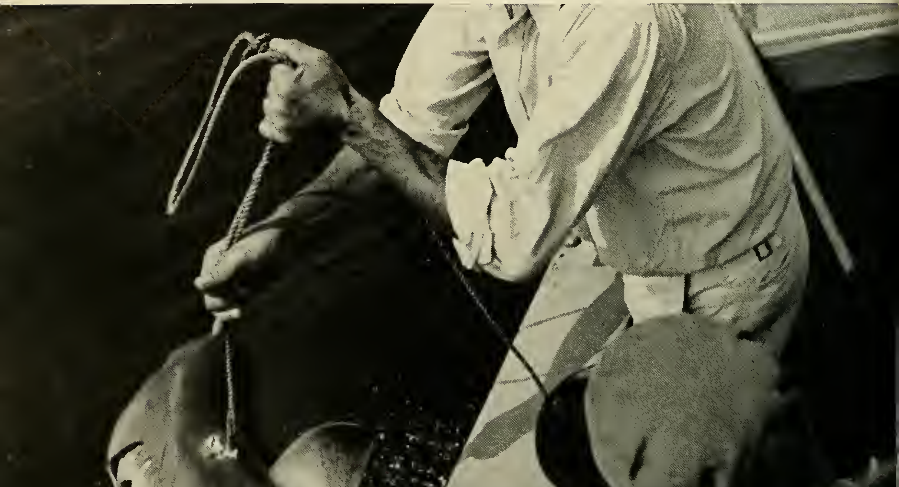
The shark has recently become of commercial value, and companies are profitably fishing for him. Their catches are measured by tons, and practically all of the fish is utilized. Large nets are generally used, but in the above photograph we see a Mako Shark about to be harpooned after a two-hour battle with hook and line

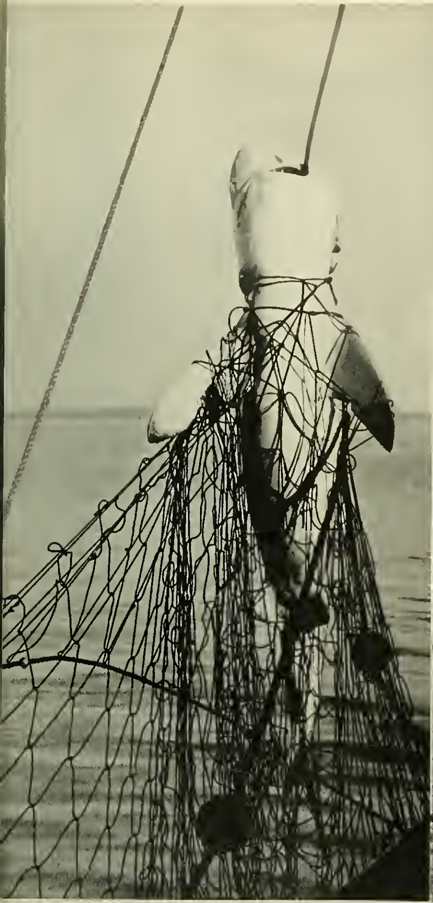
Shark fishermen hauling in a Nurse Shark to be converted into shoe leather. Formerly, shark hide or "shagreen" was used mainly as an abrasive, like sandpaper, and for covering tool handles. Recently a process for removing the rough denticles of the skin has made it possible to convert shark skin into a beautiful and serviceable leather, called galuchat

(Globe Photo)

Snapping jaws and thrashing tail make the task of landing a shark dangerous. A harpoon or swordfish dart is generally driven into the fish when it is brought alongside, but it is well-nigh impossible to judge when he is dead. The author of the accompanying article has seen a shark whose liver had been removed swim strongly away, and on one occasion a shark which had been in the boat nearly an hour knocked a boatman over the gunwale

(Photo by Rudolph H. Hoffman, from Black Star)



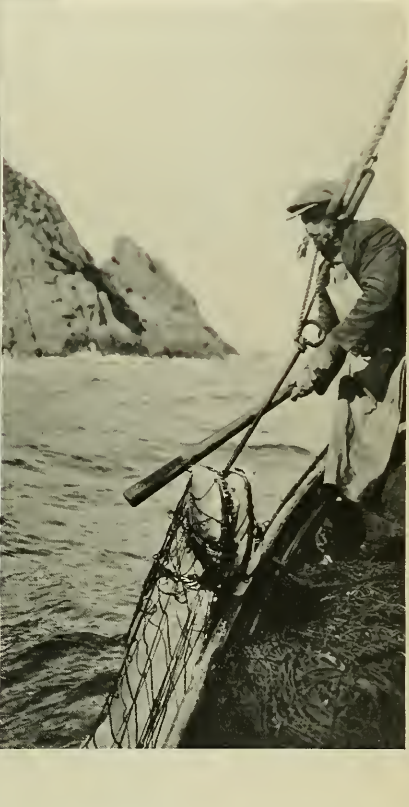


(Mondiale from Black Star)

(Above) The shark runs his head through the net and in threshing about entangles his fins. At the surface a large iron hook is fastened through his jaws and he is then hauled out with a derrick

(Below) At the rail a death-blow is easily delivered on the snout, where the shark's brain lies close to the surface.

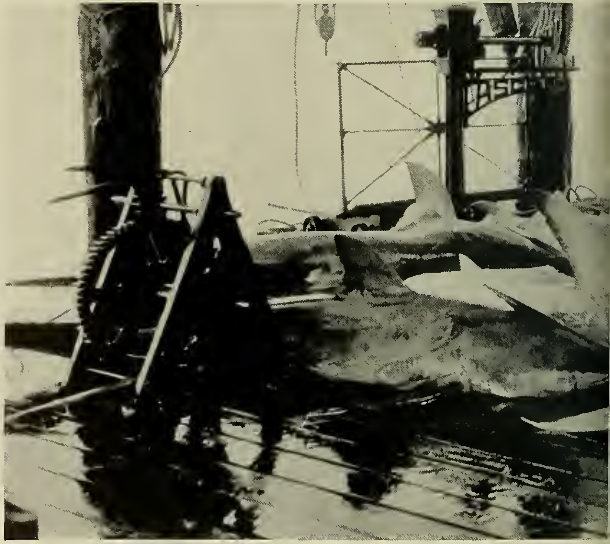
(Mondiale from Black Star)



Courtesy of E. M. Scheutz

(Above) Tons of Tiger Sharks: a haul of the National Fisheries Corporation ready for processing

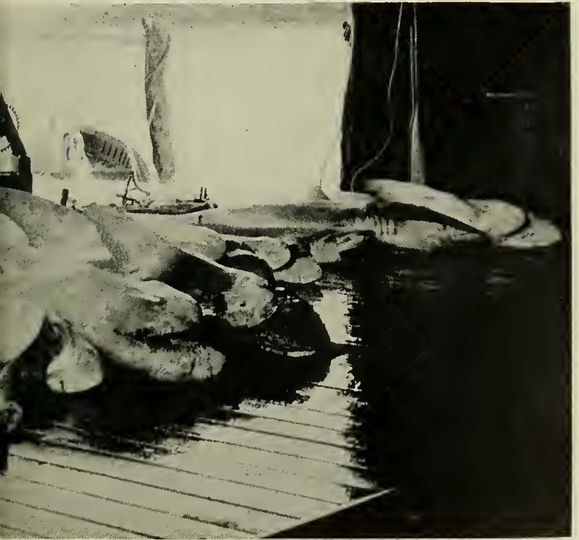
The liver of a six-foot shark will yield four gallons of oil, useful in tempering steel, in making paint, and in many other

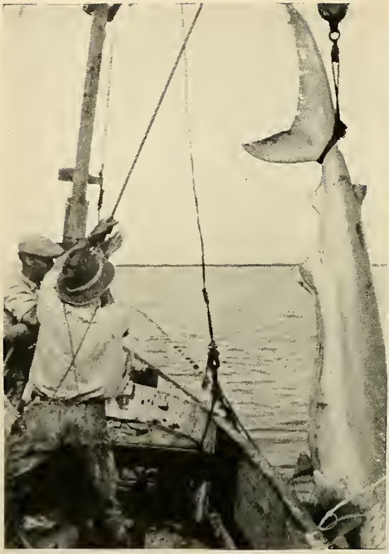


Courtesy of E. M. Scheutz

commercial ways. Medicinally, shark liver oil possesses vitamines which make it a rival of cod liver oil

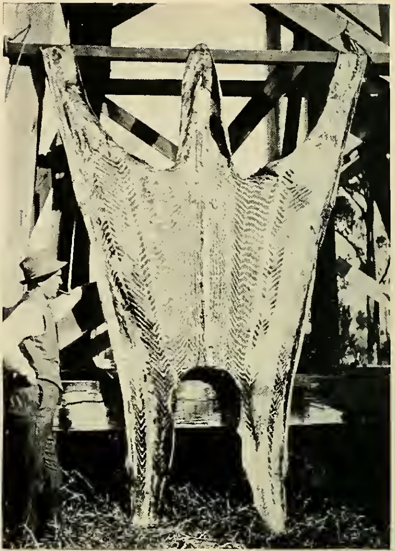
(Below) A 24-hour catch of Tiger and other sharks off the Australian coast *(Mondiale from Black Star)*





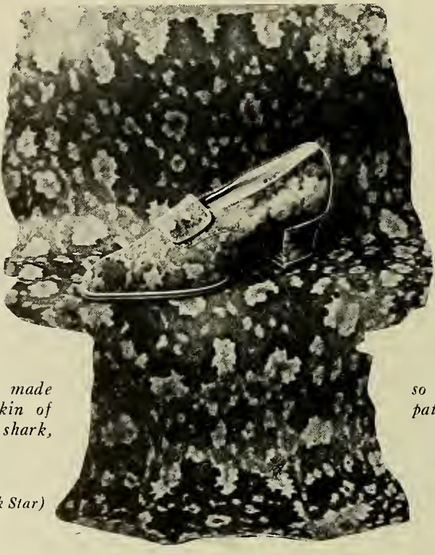
(Courtesy of E. M. Scheutz)

A big Tiger. This fellow will provide leather for shoes, bags, belts, and pocketbooks; ten gallons of oil and lots of shark fin soup



(Mondiale from Black Star)

Tanned hide of a shark: 42 square feet of leather. Before the denticles are removed the "shagreen" is useful for sanding and cleaning decks



Leather and shoe made from the tanned skin of the smaller carpet shark, so called because of the pattern

(Mondiale from Black Star)

Ice from the Thunderclouds

Hail—A $200,000,000 yearly menace; its cause and attempted prevention; record hailstones and hailstorms that changed the course of history

By CHARLES FITZHUGH TALMAN
Late Meteorological Consultant, U. S. Weather Bureau

When a record of weather occurrences tells us that hail has fallen, the statement may seem definite to the layman but often raises a question in the mind of the meteorologist. For centuries people talked and wrote about hail before it occurred to men of science to inquire whether one and the same thing was always described under this name.

What is hail?

There are at least three different kinds of icy lumps and pellets that fall from the sky, and they have all been called hail. What science now regards as true hail occurs only in connection with thunderstorms, either incipient or fully developed, and therefore chiefly in warm weather. It often falls in tornadoes, but probably only when these occur in a thunderstorm area. Hail, as thus distinguished, consists of balls or irregular lumps, each of which, on examination, is usually found to have an opaque snow-like center, surrounded by ice, which is often in alternately clear and opaque layers.

The second class of icy particles takes the form of miniature snowballs, about the size of large shot or small peas. It falls in cold weather, often in conjunction with ordinary snow. Because it readily crumbles, English-speaking meteorologists have commonly called it "soft hail"; but this term is now giving way to the Germain name "graupel."

Lastly, little pellets or angular particles of clear ice sometimes fall in cold weather. These frozen drops, though fairly common, have, until recently, enjoyed the distinction of being anonymous, so far as the scientific world was concerned. In the year 1916, the United States Weather Bureau took the bull by the horns and decreed that such ice particles should be called "sleet"—a word, alas! of many meanings.

A clue to the origin of hail is furnished by the appearance of the typical hailstone. The successive layers of clear and snowy ice are evidently acquired in the course of several journeys up and down, between relatively cold and relatively warm regions of the atmosphere, before the stone finally falls to earth. At high levels the incipient hailstone is coated with snow, and at lower levels with rain, which turns to ice as the stone is again carried aloft. Probably the only place where such a process could occur is in the turbulent uprush of air at the front of a thunderstorm, consisting, as it does, of blasts violent enough to drive a heavy hailstone upward, alternating with lulls that would permit it to fall.

Red hail

Most hailstones are approximately spherical or somewhat conical, but other and very striking shapes are sometimes found. Occasionally the surface is encrusted with curious crystalline growths. Red hail is not unknown. As in many cases of red rain and snow, the color is due to fine dust in the atmosphere, generally blown up from deserts.

Many descriptions of hailstorms tell of a roaring or rattling sound heard during the approach of the storm and apparently coming from the clouds. Some writers compare it to that of heavy vehicles passing over a road or the clatter of many horses' hoofs. Typical of the accounts of it found in the older works on meteorology is the following from a once standard treatise by Professor Loomis:

"Some seconds before the fall of hail, and occasionally several minutes, a peculiar crackling noise is heard in the air. It has been compared to the noise of walnuts violently shaken up in a bag. This noise has been ascribed to the great velocity with which the hailstones are driven through the air, while some have ascribed it to feeble electrical discharges from one hailstone to another."

The noise has not been the subject of much critical investigation, but the best guess as to its origin is probably that offered as long ago as the year 1885 by the French meteorologist, J. N. Plumandon. According to this authority it does not come from the air or the clouds, but is merely the combined sound of many hailstones falling on leaves, roofs and the like at some distance from the observer. When the storm is actually at hand, the observer hears the patter of individual stones in place of the mingled noises of a great number.

Big tales of big hailstorms

India is the home of big hailstorms and of big tales concerning them. Many of these storms have cost from half a dozen to a dozen human lives, one is supposed to have killed 84 people, and another is known to have killed three times that number. It appears, also, that Indian hailstones assume remarkable sizes, but it is not necessary to take too seriously the records of four cases that Dr. George Buist, F.R.S., reported to the British Association in 1855.

"One," he says, "near Seringapatam, in the end of the eighteenth century, is said to have been the size of an elephant. It took three days to melt. In 1826 a mass of ice nearly a cubic yard in size fell in Khandesh. In April, 1838, a mass of hailstones, 20 feet in its largest diameter, fell at Dharwar. On May 22, 1838, after a violent hailstorm 80 miles south of Bangalore, an immense block of ice consisting of hailstones cemented together was found in a dry well."

Dr. Buist recognized the fact that in all four of these cases the icy masses must have been aggregations of numerous hailstones frozen together, but he seems to have believed that in some cases the coalescence of the stones might have occurred in the midst of a vortex or whirlwind before the hailstones reached the ground. This idea can hardly be entertained at the present time. It is safe to say that, if blocks of ice of the sizes reported were actually found after hailstorms, they were formed by the freezing together of hailstones lying closely packed together on the earth.

Nearly all records of exceptionally big hailstones are vitiated by some degree of uncertainty as to whether the reported masses of ice fell as such or were formed by coalescence after falling. So far as I am aware, the biggest credibly reported object that, from its appearance and the circumstances of its fall, may be safely assumed to have been a single hailstone was one that fell through the tile roof of a house in the village of Heidgraben, Germany, August 19, 1925. The stone was picked up on the floor of the upper story and measured, and the dimensions were found to be 9.8 x 5.5 x 4.7 inches. Unfortunately it was not weighed. If it had consisted entirely of ordinary ice its weight would have been about 4½ pounds, but a hailstone is composed partly of snow-like ice, containing much imprisoned air, so that it is less dense than pure ice and the actual weight must have been considerably less than this.

Pound and a half stone

The biggest hailstone thus far on record for the United States fell at Potter, Cheyenne County, Nebraska, July 6, 1928. It was approximately spherical, and when broken open was found to consist of concentric layers of alternately clear and snowy ice around a common center, showing that it was a single stone. It was 17 inches in circumference and weighed a pound and a half.

Since, as I have stated, a hailstone grows gradually in the air in the course of its upward and downward journeys, the size it eventually attains depends upon its density, its shape and the strength of the vertical air current that supports it just before it falls to earth. Judging from the meager data we possess concerning the maximum violence of thunderstorm updrafts, it would seem that something less than five pounds is the extreme possible weight of a hailstone, while a two-pound hailstone would deserve a place in a museum if it could be preserved there.

There is a proverb in eastern Europe that says: "Hail brings not hunger." This refers to the fact that although, where hail falls, the crops may be annihilated, the damage is never so widespread as to cause a general famine. A hailstorm is always confined to a relatively small area—much smaller than that of the thunderstorm of which it is an episode—though its narrow track may be scores or even hundreds of miles in length. Thus it happens that although a great many destructive hailstorms occur every year, the majority of human beings never experience one in the course of their lives.

Another result of the sporadic and local character of hailstorms is that, though statistics of hail occurrence are collected in most civilized countries, many of these storms fail to be recorded. In the United States the Weather Bureau collects reports of hailstorms from something like 5,000 observers and obtains many additional reports from press dispatches, which are carefully checked up at the various "section centers," where climatological data are assembled.

Damage from hailstorms

The Bureau has averaged the data of damaging hailstorms and published it in chart form. In this chart the country is divided into equal sections 100 miles square (area 10,000 square miles), and figures show the average annual frequency of damaging hailstorms within each of these sections.

The largest figures, showing from two to between four and five storms a year, are found in an irregular belt that includes Kansas, Iowa and parts of Indiana, Ohio and southern Michigan, while in much of the Southwest the average annual frequency is recorded as zero, though there are only minor areas in which no damaging hailstorm was observed during the entire twelve years. There is no place in the United States at which the average interval between damaging hailstorms does not amount to several years.

According to an estimate that has become rooted in statistical literature, though it is probably much too small, hail causes throughout the world losses averaging about $200,000,000 a year. In the United States an estimate by V. N. Valgren, of the Department of Agriculture, based upon an 11-year record, indicates that the losses on ten leading agricultural crops of this country—viz., wheat, corn, oats, barley, flaxseed, rice, potatoes, tobacco, hay and cotton—average $47,500,000 a year. In 1915 the losses on these crops totaled $69,000,000. The same authority estimates that hail damage to crops and property of all kinds in the United States amounts, on an average, to at least $75,000,000 a year.

A $5,000,000 hailstorm

In 1928 there were two hailstorms in the State of Kansas that injured crops to the extent of $3,000,000 each, and on August 18, 1925, a single hailstorm is supposed to have cost the farmers of Iowa about $5,000,000, besides doing damage to the extent of $500,000 in the adjacent State of Illinois. No part of the country east of the Rockies is exempt from these disasters, and they occur occasionally even in the Far West. Fresno, California, had a $50,000 hailstorm on October 5, 1925. What ruin hail can accomplish in New England is illustrated by the million-dollar hailstorm in the tobacco-growing region of Connecticut on August 1, 1929.

That hail can work huge havoc in a city as well as in the country was shown in the case of the famous Dallas, Tex., hailstorm of May 8, 1926—the most destructive that has occurred thus far in any of our cities. The total damage in and about Dallas was estimated at $2,000,000, and the brunt of the destruction was experienced in the business center of the town. Here the hailstones in many cases were three inches in diameter. Tons of ice fell on streets and buildings during a period of fifteen minutes. Not only were thousands of windows and skylights broken, but roofs of all kinds were wrecked to such an extent that the Mayor issued a proclamation authorizing owners to make needed repairs without first getting the usual building permits. Street lights and electric signs were shattered, and there was the usual riddling of greenhouses. The distinctly modern note of the disaster was the immense amount of damage done to automobiles, estimated at more than $100,000.

How the ancient Greeks attempted to keep hailstorms from devastating their crops and vineyards is told in Seneca's "Quæstiones Naturales." The town of Cleonae, in Argolis, he says, employed watchmen to give warning of the approach of hail clouds, which were recognized by their color. When the alarm was sounded people sacrificed a lamb or a pullet;

whereupon, it was alleged, the threatening clouds changed their course. Those who had no animals to sacrifice scratched their fingers with a sharp stylus, and this was supposed to be equally efficacious—as it undoubtedly was!

In the days of Charlemagne European peasants set up tall poles in their fields bearing at the top strips of parchment inscribed with incantations against hail.

Various charms are still employed in rural Italy to avert hailstorms. Professer Giuseppe Bellucci tells us how, in Umbria, the peasants on Palm Sunday attach to the tops of trees adjacent to their fields consecrated olive branches or bits of charred wood from the Yule log. In some districts they spread ashes from the Yule log tree on the fields in the shape of a cross, or hang amulets and religious emblems of various kinds on the trees, or ring little silver bells—all to keep away hailstorms.

Quaint machines to prevent hail

In the early years of the present century much was heard about two contrivances widely employed in Europe, especially by vine-growers, for the purpose of preventing the destructive effects of hail. One was the hail-rod; known in France as the "electric Niagara." This was merely an extra large and lofty lightning-rod. It was supposed to draw off electricity from the storm clouds and thereby—though nobody ever explained why—to prevent hail from falling in its vicinity, or to render it soft and harmless when it fell. Many hail-rods were erected in France under government auspices, but they now appear to be completely neglected and forgotten—as they deserve to be. They were perfectly useless.

The other equally futile device was the hail-cannon; a special form of mortar, which discharged a whirling ring of smoke and gas but no solid projectile. Thousands of these cannon were used in Austria, Italy, France and elsewhere. They are now nearly obsolete, but they have been replaced in many regions by the hail-rocket, which bursts high in the air and hence is alleged (especially by its manufacturers!) to concentrate its effects where they will do the most good. The truth is, however, that the rocket bursts far below the level where hail is formed, and that, no matter where it burst, it could not conceivably affect the formation or the fall of hail.

Still another delusive contrivance is the hail-kite, invented in Russia. This is really an assemblage of box-kites, carrying sirens, which are operated electrically from the ground end of the kite wire. They emit a loud continuous note, and the resulting vibration of the air is supposed, in some miraculous way, to nip the hailstorm in the bud.

A storm that changed a king's mind

A hailstorm that played an important part in history occurred in April, 1360. The English had long been at war with the French. Edward III, after an unsuccessful attempt to take Paris, had withdrawn his army toward Chartres. The French offered to negotiate peace, but the English king was stubborn. Then came the storm, which is thus described by Froissart:

"During the time that the French commissioners were passing backwards and forwards from the king to his council and unable to obtain any favorable answer to their efforts, there happened such a storm and violent tempest of thunder and hail, which fell on the English army, that it seemed as if the world were come to an end. The hailstones were so large as to kill men and beasts, and the boldest were frightened. The king turned himself toward the church of Our Lady at Chartres, and religiously vowed to the Virgin, as he has since confessed, that he would accept terms of peace." The result was the Treaty of Brétigny.

The chronicles of the time place the English losses from this storm at 1,000 men and 6,000 horses; probably an exaggeration.

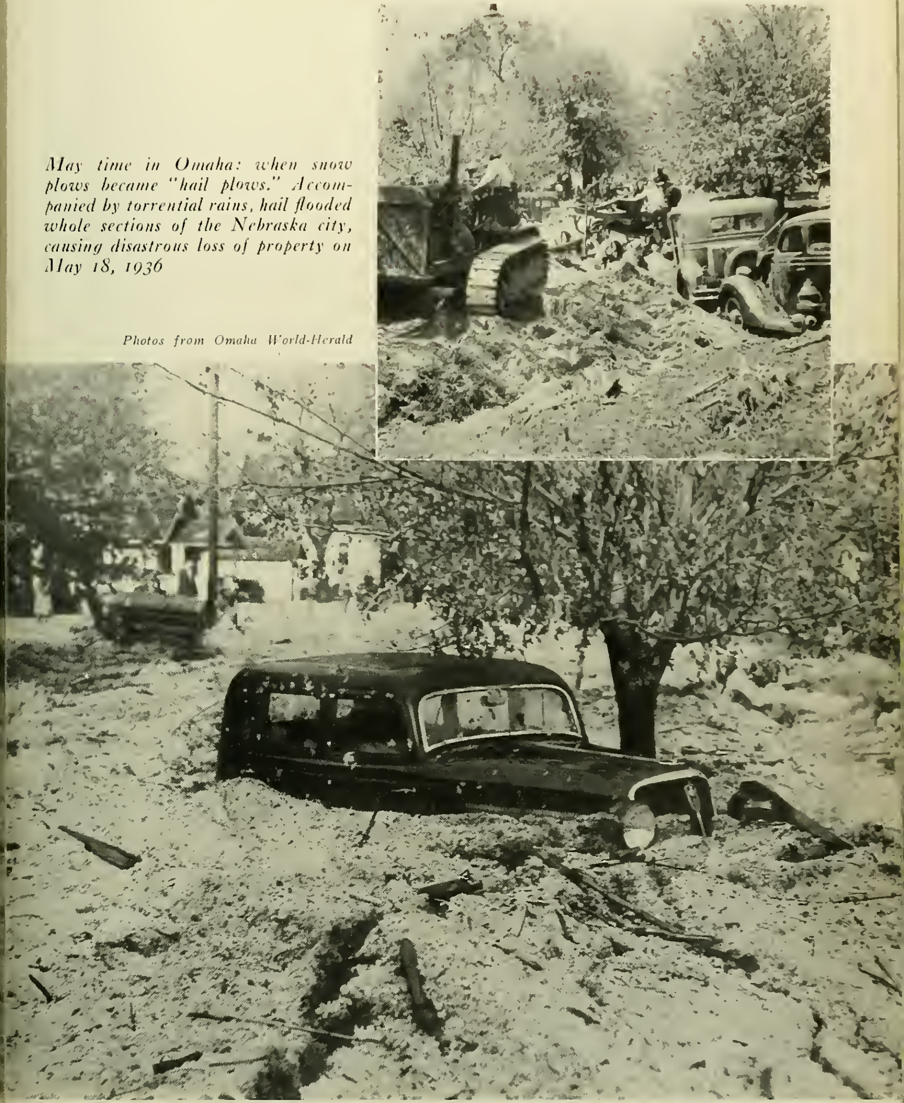
Another hailstorm that lives in history is the one that happened in Europe on July 13, 1788. Beginning in the center of France in the early morning, it passed northward in two parallel bands, about twelve miles apart, crossed Belgium, and finally died out in Holland in the afternoon. The western band was about ten miles wide and 420 miles long; the eastern, five miles wide and nearly 500 miles long. Profound darkness preceded the passage of the storm. The hail lasted only seven or eight minutes at any one place.

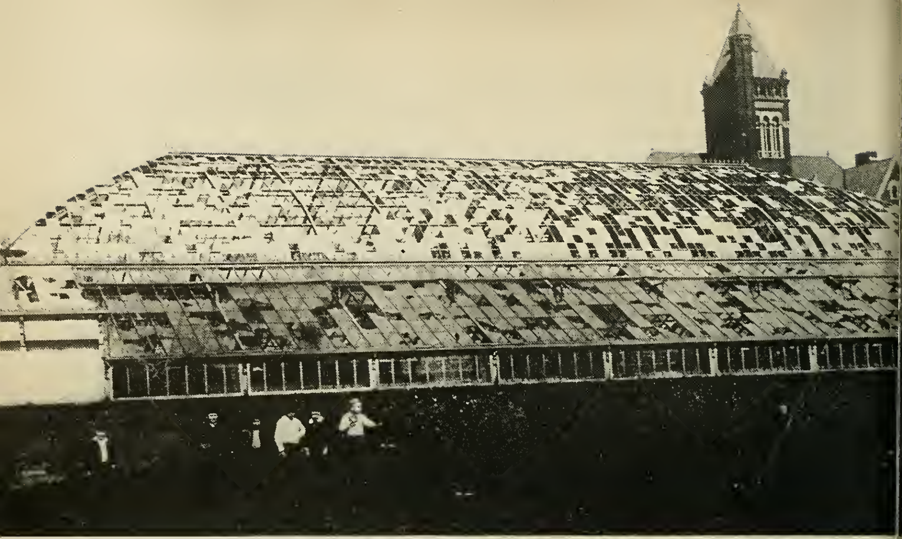
No less than 1309 communes in France suffered from this visitation, and the total loss was nearly $5,000,000. It is said that the distress occasioned by the storm hastened the outbreak of the French Revolution.

Ice from the Thunderclouds

May time in Omaha: when snow plows became "hail plows." Accompanied by torrential rains, hail flooded whole sections of the Nebraska city, causing disastrous loss of property on May 18, 1936

Photos from Omaha World-Herald





C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Above) Greenhouse glass pays huge yearly toll to hail: this Pittsburgh storm smashed tens of thousands of dollars in window panes

(Below) Devastation in an orchard: the whole top is battered off this Leesburg, Virginia apple tree

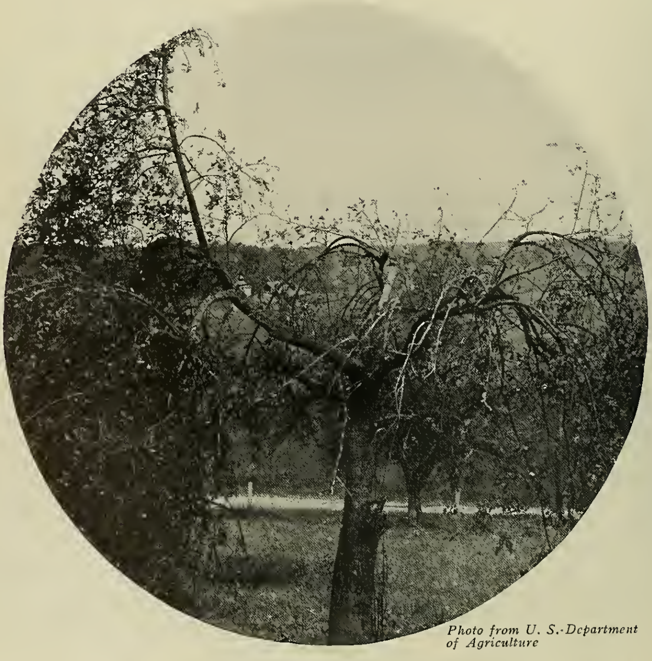


Photo from U. S. Department of Agriculture

Photo U. S. Geological Survey

(Above) Shell holes of the frozen blast: impressions of hailstones in soft mud. Similar prints formed in bygone geological ages are today preserved where mud has become stone

(Below) Icy "boll weevil": hail-ruined cotton plants stripped of their leaves

C. F. Talman, U. S. Weather Bureau, Washington, D. C.

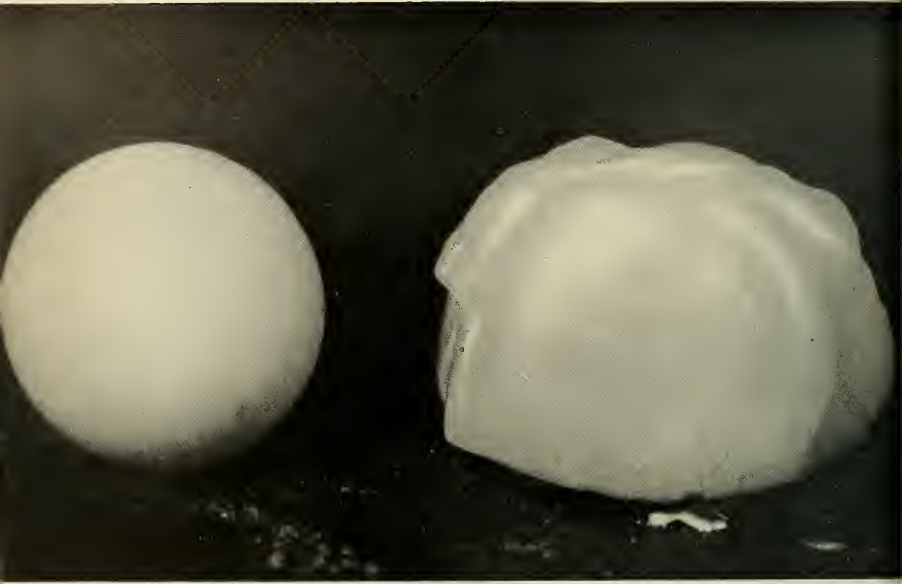


Photo Lynn Acutt, Durban, South Africa

(Above) Big as a tennis ball: actual specimen of the hail that fell at Durban, South Africa, June 24, 1929, compared to a standard tennis ball. Storm-damage estimated at £750,000

(Right) Hailstones laugh at shingles: a typical scene after the great Dallas, Texas hailstorm of May 8, 1926

C. F. Talman, U. S. Weather Bureau, Washington, D. C.

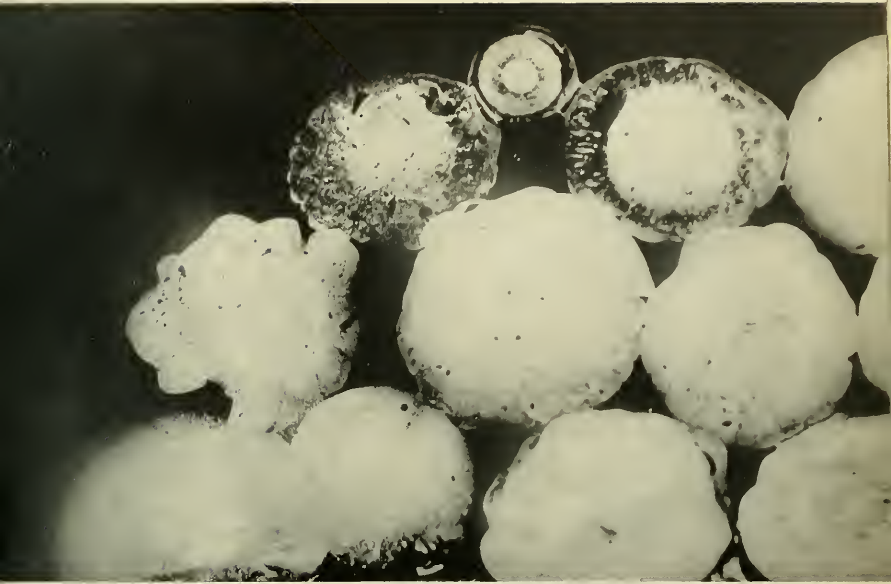
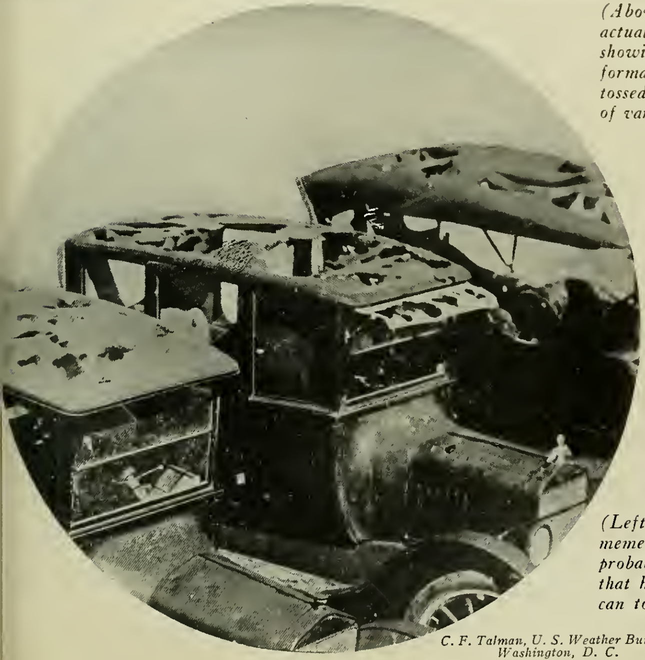


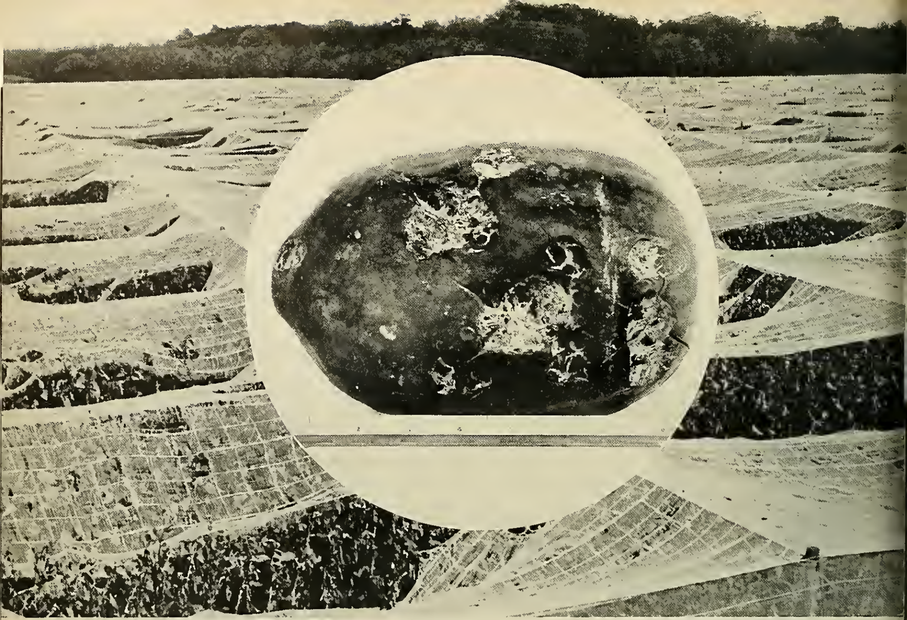
Photo by H. Metcalfe

(Above) Bullets from the sky: actual size photos of hailstones showing their onion-like layers, a formation produced as they are tossed through different air strata of varying temperature



(Left) Riddled automobile roofs: mementos of the Dallas storm, probably the most destructive that has ever ravaged an American town

C. F. Talman, U. S. Weather Bureau, Washington, D. C.



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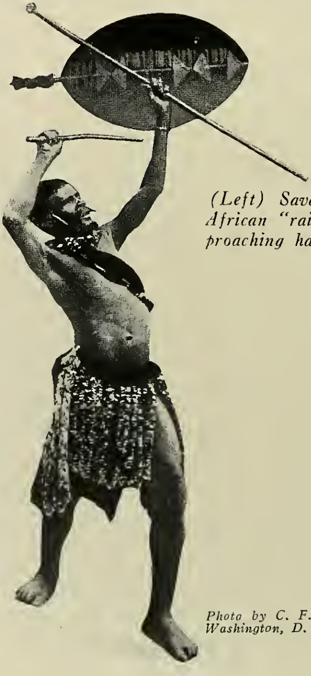
(Insert) What hailstones did to a watermelon. (Background) A futile attempt to "bomb-proof" a Connecticut tobacco field: loosely woven canvas ripped by the devastating pellets



(Left) Savage versus hail: A south African "rain doctor" fighting an approaching hailstorm

Photo by C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Right) When the "hail-shooting" mania was at its height. An exhibition of the hail cannon at Padua, Italy

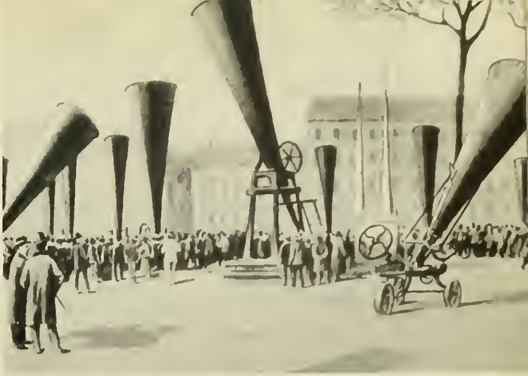
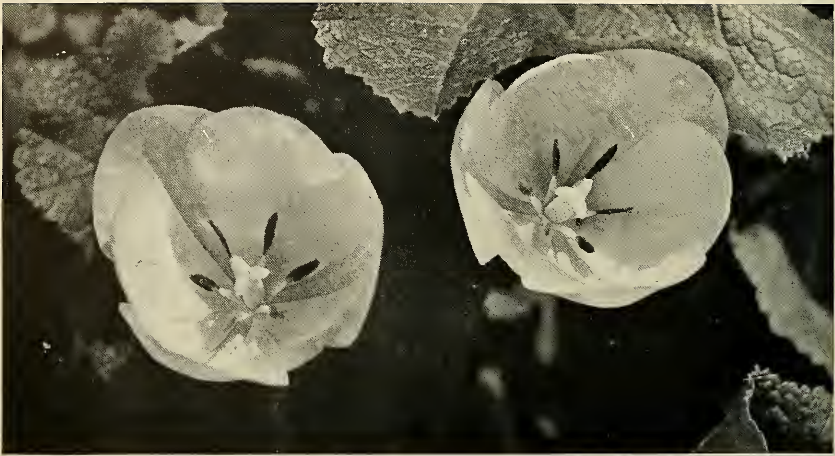


Photo by C. F. Talman, U. S. Weather Bureau, Washington, D. C.

(Left) Man's futile retaliation: cannonading the clouds. A counter-barrage method of "protection" formerly in high favor in the old world. (A painting by Jules Guerin)

Photo courtesy Everybody's Magazine

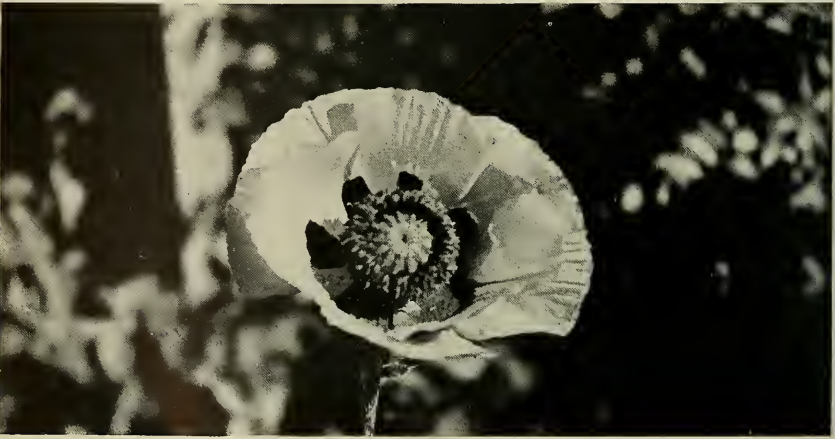


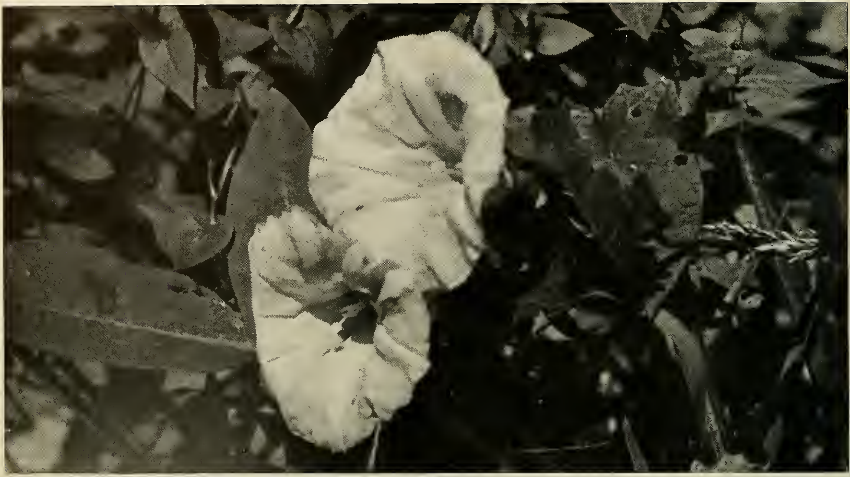
Flowers that "Go to Sleep"

An Unusual Series of Photographs by Frank S. Gehr

People do not usually realize the extent to which common flowers close at night and open again with daylight. The upper picture shows two yellow tulips as they appeared in the middle of the day, whereas the one opposite it on the right-hand page shows the same flowers closed at night not many hours later

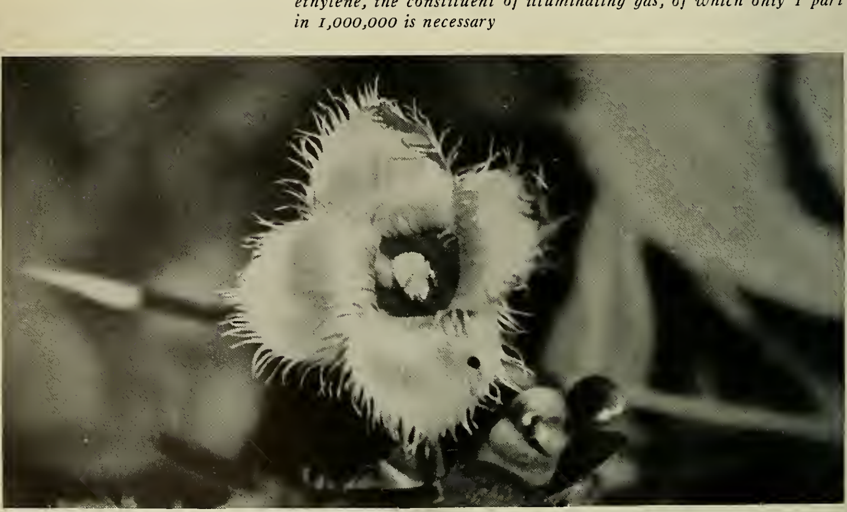
Although temperature and moisture have some effect, sunlight is the most important factor in the strange movements which flowers undergo. The red oriental poppy, illustrated below, is one of the flowers that "go to sleep" when it is dark, as you can see from the photograph opposite taken at night

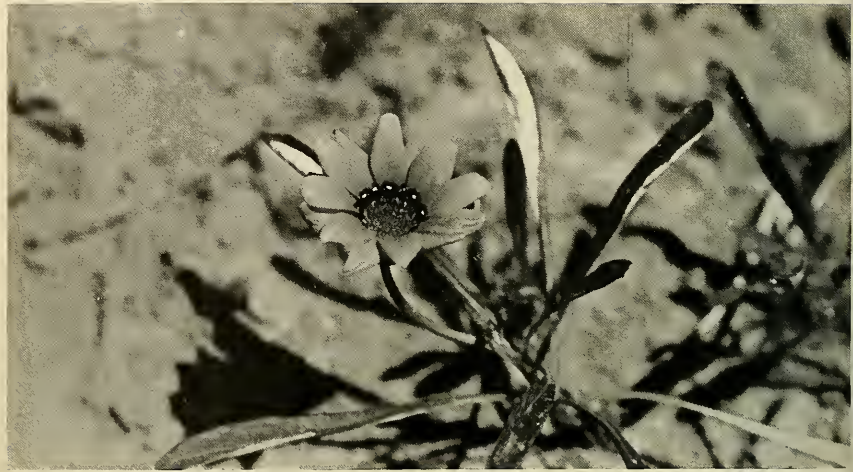




(Above) A wild morning glory "awake" in the sun
(Opposite) The same flowers "asleep" at night. A number of morning glories only open for one day

(Below) A fringed gentian in daylight
(Opposite) The same flower as it appears at night or on a dark day. The movements of plants can be stopped by anaesthetics like ethylene, the constituent of illuminating gas, of which only 1 part in 1,000,000 is necessary

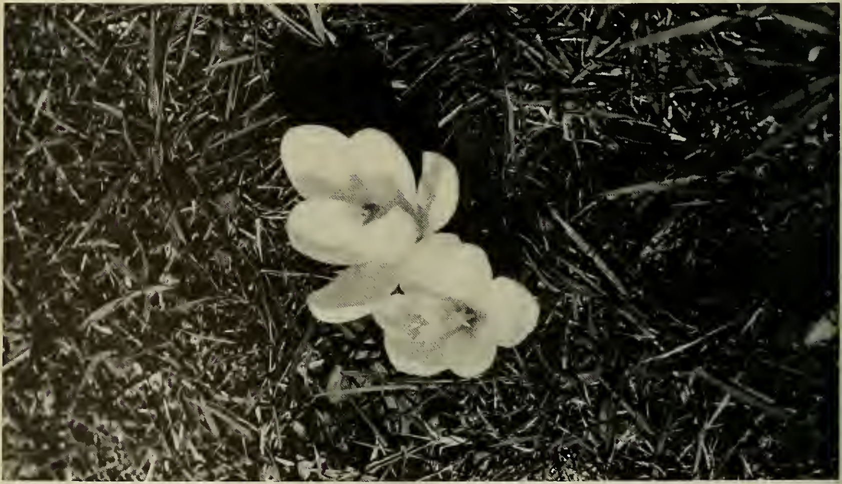




The African daisy in the above photograph is open because the sun is shining on it; but when photographed at night by flashlight the flower is seen to have closed completely

(Below) White crocuses in sunlight

(Opposite) At night the photographer finds them "sleeping." There are other flowers, however, which reverse the movements shown in this series, opening at night and remaining shut during the day



José — 1936

Further adventures of a little animal whose only friend was man; the coati which won a place on the American Museum's expedition at Barro Colorado

By FRANK M. CHAPMAN
Curator of Birds, American Museum of Natural History

[THE STORY SO FAR: In December, 1934, this racoon-like little animal met and won the friendship of Dr. Frank M. Chapman on Barro Colorado Island, in the Canal Zone. Doctor Chapman created much interest in José among readers of NATURAL HISTORY when he recorded his subsequent relations with this wise and appealing creature in the April, 1935, issue of the magazine. He showed José to possess extraordinary intelligence, expressed chiefly through his remarkable sense of smell.

Like other animals of his kind he lived alone until, prompted by the developments of the annual mating season, he went to the forest to fight for a mate. After an absence of about two weeks he returned from his adventures minus an eye and an upper lip and with various other wounds. Fed by members of the Barro Colorado staff he survived the summer and returned to Doctor Chapman's care the following November.

In the present article Doctor Chapman continues the story of José's life until they again separated in April, 1936.]

AFTER my departure from Barro Colorado in April, 1935, José was adopted by the laboratory family. Possibly it would be more accurate to say that the family was adopted by José. At any rate, seven months later I found him occupying much the same position as a household cat, notoriously a spoiled creature of independent ways.

Bananas, please!

He had established his headquarters at the entrances to the laboratory and kitchen, digging a slight hollow in the earth beneath the water tank in which at times, he rested. From this retreat, when hunger prompted, he issued to hold up whoever chanced to pass for food, meaning always bananas. His request was wordless but made with unmistakable motions as, on his hind legs, he came confidently forward. If no fruit was forthcoming he retired; if it was held beyond his reach, he did not hesitate to climb for it and the marks of his claws on one's legs bore evidence to their sharpness and the strength of their owner's grip. This experiment was not repeated.

Weight no handicap

José had not been able to replace his injured eye, but his upper lip was in large measure restored, leaving a scar visible only to those who looked for it. Of his numerous bodily wounds there was no outward evidence while his general physical condition bespoke leisure, repose, and abundant food. José's figure had indeed lost the slenderness of the wild individuals of his kind. He was, unquestionably fat and showed a marked disposition to sit or lie down when not in motion. I ended this degrading life of luxury by restoring the feeding-tray on the trolley from my balcony to the forest as José's source of food. It was believed by those responsible for José's increase in weight and apparent immobility that his avoirdupois would prevent him from performing the acrobatics which had so distinguished him the preceding spring. They were mistaken.

Finding that his demands for food were no longer honored José soon accepted my invitation to return to the scene of our first meeting. There he found no bananas offered him from indulgent hands but only the scent of bananas proceeding from places beyond his immediate reach. Seven months had passed since he had been confronted by this situation. Would memory assist him in meeting it or would he employ orginal initiative?

The odor of a peeled banana on my balcony rail evidently attracted his attention and, nose up, he "tried the air" in familiar fashion. At once he came to the balcony floor, leaving it and returning several times before he located the food on the rail. This was distinctly below his average performance of the preceding spring. And twice he visited the rail before he discovered a second banana on the crossbar of the three-foot upright to which the feeding-tray trolley wires are attached. This he climbed with some little effort, remaining on it to eat his reward.

He seemed to be aware of still further food in the feeding-tray about eighteen feet distant and started to walk the trolley wires toward it but after one step returned to the cross-piece and descended to the ground. Thirty minutes later he returned without hesitation for a fresh piece of banana on the cross-piece but made no attempt to go to the tray. In another half hour he again came to the cross-piece for the always acceptable banana. As before, he started on the wires for the tray but after a foot gave it up and retreated to the ground. But there was still banana in the air, and with characteristic coati persistence José soon returned to the cross-piece and finding no more banana there turned his whole attention toward the tray, where a lone banana remained. For the first time he now encountered the cord by which the tray was pulled to and fro. It was of the same kind as that used in various banana experiments with him the preceding spring and its touch seemed at once to arouse memories of bananas which had then always been attached to it. At once he pulled it vigorously and, when this brought no result, as before he bit it until I interfered.

This ended the tests for the day. They showed plainly that José was far from losing either his mobility or initiative and that when the right cord was touched his memory was responsive.

Walking the wire

The following morning, November 30, at 10:50, José returned, climbed up the steps of the balcony where I was sitting, and came to me obviously for food. I referred him to the crossbar and tray where bananas awaited him. But for reasons, if any, known only to himself, he descended the two steps to the ground and went directly to the woods thirty feet away. Passing the tree to which the far end of the trolley wires are attached, and which was still encircled by the impassable zinc "rat-guard," he started to climb the following tree but after ascending several feet slipped back to the ground. "Ha ha," I said, "it's too much for you," but without pause he continued to the succeeding tree. Evidently it had required only two or three steps to show him that this second tree was not the right one. But on the third tree he obviously felt at home and confidently climbing to the point where it met the "trolley tree" he crossed over, descended that tree to the wire and without a moment's pause walked out on one wire, resting his tail on the other, to the tray ten feet away. He acted as though wholly accustomed to the maneuver, ate his banana while resting easily on the tray, and then at once retraced his route to the ground. On this, his first trial, therefore, with only the slight, quickly corrected slip of starting up the wrong tree, he remembered his indirect route to the tray and followed it without difficulty. He did not, however, seem to climb as easily as in the preceding spring and, when ascending, stopped three times to rest a few seconds while panting rapidly. But within a few days he was an agile as ever. Why he should have balked at the wires the first day and treated them so familiarly the next I am unable to say. Possibly because at the forest end of the route to the tray they formed a regular part of an unbroken succession of events, while the balcony route was broken by various incidental experiences.

José's rivals

These two days served completely to restore the relations with José which had been broken by my seven months' absence. Meanwhile his existence had become somewhat complicated by the appearance of several rivals for our favor. These animals, known as Miguel, Julio, and Antonio, observing the ease with which José supplemented the food supplied by the forest, had not hesitated to advance their own claims for bananas and each found one or more patrons among the workers on the island. But although these later comers were still fed at the entrances to kitchen and laboratory they did not hesitate to poach on

José's preserves at my balcony. When he was present they did not venture to trespass, for they apparently recognized his seniority, and, in a swinging gallop, always retreated before him. But José sometimes had affairs of his own to attend to and when absent these trespassers soon also learned to reach the various places in which I offered bananas to possible bird visitors.

Within an hour after the feeding-tray had been cleared of the enveloping luxuriant vegetation of the wet season and supplied with a banana, it was visited by doubtless the same tanagers that had frequented it the preceding spring. They were soon joined by two blue tanagers and an adult female and young male of our summer tanager, wintering here. At times all three species were present together, an apparent recognition of family relationships or, at least, an exhibition of similar tastes, which resulted in a singularly beautiful picture. But if I expected to continue to receive these birds as guests I must find some way of protecting their dining-table from an intruder who would not hesitate to make them part of his meal. I therefore returned to the problem of making a coati-proof dining-table for birds. If a tray on two trolley wires could be reached so easily, possibly a tray on a single wire would be beyond a coati's powers. Two wires supplied one for the feet and one for the tail, making a stable means of locomotion. But with the tail support removed, Mr. Coati would find himself strictly without visible means of balance. Moreover, recalling something about the super-skill required to walk a "slack rope," I resolved that as a final deterrent my wire should be of the slackest. So I dropped it nearly four feet in sixteen, or to an angle of about twenty-three degrees, confident that the food-tray was now for flying creatures only, birds by day and bats by night.

With the greatest of ease

But José mastered the new contrivance at the first attempt. It is true his little journey was ended so hastily that the tray turned over with him. But he lost neither his head nor his footing while the banana was grabbed as it swung above him and devoured before he resumed his journey upside down and returned to the tree somewhat winded but experienced. After lunch the journey was repeated with everything under control and it was evident that while I had added to José's skill I had in no way reduced his sources of food. Thereafter, I tried to keep the tray so well supplied that there would be enough bananas for both birds and coatis. But I did not confess myself defeated. I still thought that there must be places open to winged creatures and closed to quadrupeds and I looked to the trees.

Tying a banana at each end of a three or four foot string I tossed them to the outer branches of the trees over my balcony. Some barely caught and hung dripping from the terminal twigs as though they had grown there. Even the tanagers could reach them only while on the wing. And the coatis? I must confess that they made me feel as though I were lacking in both experience and imagination. For them I had merely substituted a banana for an almendro nut. They climbed down the branch as far as possible and if they could reach the string pulled it in with the banana at its end. Just, indeed, as they had pulled in the bananas attached by strings to the feeding-tray. If they could not reach the string they broke off the limb to which, directly or indirectly, it was tied and pulled that in. One pair of bananas landed at the extremity of a far-reaching balsa limb twenty feet above the ground and twice that distance from the trunk of the tree; but they were unerringly located and collected. Not one banana escaped.

Making it more difficult

I deferred making the final experiment that occurred to me. Not because I believed that it, too, would fail, but because of its general inappropriateness. Taking a leaky zinc wash-tub I nailed it upside down on a stout pole about eight feet long, of which two were firmly set in the ground. Bananas were placed on its upturned bottom and there, at least, coatis tried in vain to get them. One after another the younger animals climbed the pole to the heart of the tub and dropped back to earth. But they were far from discouraged, and repeated pawings at the rim of the tub finally so weakened its fastening to the pole that it swung to and fro and a more than usually agile coati succeeded in getting his claw over the rim and, in some inexplicable way, hoisted himself up on to the bottom. In the end, therefore, not even the tub was immune and at this point I abandoned further attempts. The coatis won. The birds must take their chances. I would supply the bananas.

Meanwhile, I found that coatis were not restricted to a fare of bananas. With the ripening of the almendro nuts late in January they ascended the trees that bear them and no nut was too remote to escape picking. Only the thin rather acrid outer covering was eaten, then the nut was dropped for the peccaries, pacas, agoutis, and squirrels. This is a favorite food but even at the height of the almendro season coatis varied their fare. I was seated on my balcony one afternoon early in February when an unrecognized coati started sniffing about on the hillside near me. In a moment he was evidently assured that he had found what he wanted and began to dig. It was not a casual digging. It was a frenzy of digging. The earth, which had been in position only ten years, was comparatively loose and with stones nearly five inches in diameter it rose in a continuous eruptive shower that rumbled down the hill. Within five minutes the animal was lost to view in his own excavation. At the end of that time he withdrew his prize—a tarantula which, barring two claws, was devoured on the spot. The hole was thirty-two inches deep and fourteen inches wide at the entrance.

Fond of eggs

There is a general, and I think, warranted belief that coatis are destructive to birds, their nests and contents, but beyond their capture of a paroquet at the laboratory I know of no instance of their bird-eating. As a means of gaining more information we therefore placed two hens' eggs where they would be seen by wild coatis. Their action was prompt and definite. One egg was soon carried unbroken to a distance of a hundred feet before eating, the other was devoured on the spot. The top was neatly removed from each egg and the exposed contents then lapped up as though from an egg cup. One could imagine that such skill could be acquired only by experience, perhaps with tinamous' eggs.

To vary this test I hid two eggs at different spots in the grass on the hillside near my balcony. One egg was not handled and was placed with the aid of a tablespoon attached to a long pole. It was never visited. The other was hidden by hand and visited frequently. Neither egg was taken and the experiment is mentioned only to suggest that it be repeated.

That an animal so fond of bananas should also have a pronounced if not indeed passionate liking for tarantulas helps prepare us for the statement that coatis are also fond of bats!

When at night I explored the forest from my balcony with a powerful searchlight, its rays were often thronged by bats of several species. Some were fruit-eaters and in a steady line came for a bite of the banana in my food-tray. Others appeared to be insect-eaters, darting erratically here and there. To capture specimens for identification, like a great spider I spun my web, in the form of an Italian bird net, thirty feet long and six feet wide, between me and the forest. The bats caught were presumably fruit-eaters, which apparently lack the sensitiveness that aids insect-eating bats to avoid objects when in flight. But if they became entangled in a part of the net within reach of tree or hillside only the wings were left for me while a coati appropriated the still living body. I therefore abandoned this form of collecting and restricted further experiments on the food of coatis to cake and candy, both of which they refused. Of bananas, however, they never tired and even the ripest specimen was acceptable.

While José seemed in perfect physical condition it is clear that at the end of January, 1936, as the annual mating season approached, he was not as well prepared for its tests as he had been the year before. He was much overweight, a diet of bananas was doubtless not as strengthening as one more varied and more difficult of acquisition, and he was minus the eye lost in last year's mating contests. Consequently, if there is any truth in the theory that an animal physically below par is seriously handicapped in the struggle for existence, José entered the lists of the 1936 mating season under a marked disadvantage.

José's marital expedition

The result supported the theory. The date of his return from his marital expedition demonstrated the regularity of his physiological cycle. It will be recalled that in 1935, after an absence of two weeks, he returned to the laboratory on February 11. In 1936, after a somewhat briefer absence, he returned on February 10. In 1935 he was minus an eye and an upper lip and plus countless body wounds, some of major importance. In 1936 he had lost the use of a foot, the remaining eye was badly injured, a former shoulder wound was reopened to a length of about four inches and width of over one, and there was literally not two square inches of his body that did not show the mark of claw or tooth. José was, indeed, such a pitiable looking object that the men urged me to end his suffering. The injury to his foot was the most serious. It robbed him not only of an organ of locomotion and means of securing food, but of a weapon. The foot was swollen, its claws bent backward, and the care with which it was held from the ground indicated that it was painful. Above all, José's spirit seemed broken. He had lost his distinguishing confident attitude toward life, and after eating three bananas hobbled back to the woods, his lowered tail, like a flag at half-mast, dragging behind him.

His spirit broken

The preceding year, after returning from his campaign of conquest, José had to contend only with his wounds. We supplied him with food and in the vicinity of the laboratory he found safety from his enemies. Meanwhile other coatis of his sex have made friends with us if they have not with him. If earlier in the year they interfered with what he evidently considered his prior rights, he exhibited his authority in a manner not designed to promote his popularity. Now it was their turn and they knew it; so did he. When in the morning he returned for his daily bananas he moved cautiously, advancing only after careful inspection of the surrounding territory. Even when eating he was constantly on the alert and would suddenly stiffen to attention if he fancied he detected the presence of an enemy. This act always impressed me as an exhibition of intelligent discrimination. Did he or did he not hear or smell one of his own kind?, it seemed to say. If he concluded that he did not, he resumed eating, but if he became convinced that an enemy was nearby, the half-eaten banana was dropped abruptly. There was no questioning growl, no "trying of the air" with that sinuous nose, no querulous twisting of the snake-like tail; without a word or a moment's pause, tail dragging, he loped away in complete and shameless confession of his impotence.

But notwithstanding his evident desire to avoid further conflict, at least until he was better prepared to defend himself, it was apparent that he did not always escape. Often he showed new and more or less serious wounds and it was a question whether in spite of our care he would survive the attack of his foes. They showed him no mercy and about the laboratory, at least, appeared to be almost constantly on his heels. He could find no place where he was secure. March 3, for example, after eating four bananas on my doorstep he entered and crossed my room as though he were considering it for a retreat. But something, perhaps the confinement of four walls, evidently worried him. I stood one side to let him choose his own resting-place but he seemed in constant fear of an assault from the rear and returned to the door. Crossing the balcony to descend the steps he stopped suddenly head down, body trembling, as though about to collapse. Twenty feet away a coati was coming slowly toward him. José made no attempt to escape. He seemed to be ready to surrender. The approaching animal was one of the younger ones that he had dominated earlier in the season. José, I felt, would be helpless in his claws, so I drove him back to the forest and tried to induce José to return to my room. But this was a form of retreat he did not understand. So he pulled himself together, went down the steps and slowly climbed the hill away from his enemy.

A fierce encounter

Three days later an animal that I recognized as Miguel, after I had driven him off several times, charged José while I was feeding him at the laboratory door. The attack was made from the rear with a sudden, deadly ferocity and José responded with a power and drive that we had not supposed remained in his torn body. Miguel, evidently as much surprised as we were, quickly gave way and we completed his rout. Then to illustrate that such little incidents are all part of a coati's daily life, José, with complete composure, returned to the banana he was eating from my hand. I showed far more excitement than he did.

Meanwhile José was making a marvelous recovery from his countless wounds. What is it, one asks, that keeps his scratches, cuts and gashes free from infection? Certainly the tongue, with which alone they are washed, bears no visible healing ointment but carries the essence of one wound to another, and all alike are without traces of pus or inflammation. How places beyond the reach of his tongue were treated I do not know.* His foot alone seemed inflamed and sore but here there had been an apparent tearing of ligaments which called for replacement of claws, and possibly bones, before healing, and while progress was made it was slow. It was not until March 11 that I saw him attempt to use his injured foot, other than to walk on it. Then he dropped a banana half-eaten and sniffing along the hillside made a half-hearted attempt to unearth a tarantula. The act seemed to say "I'm tired of bananas; give me some real coati food."

During this period of daily visits José and I established closer relations than had previously existed between us. Hitherto I had been merely a source of bananas of which my hand was the container. Now he acted as though there was something in our relations besides bananas. He recognized my voice and responded to his name, coming to me, when hungry, from distances up to a hundred feet. He acted as though at home in my study where, his hunger appeased, he spent hours, chin on paws, comfortably sleeping in evident belief that he was safe there. Thus he clearly looked to me for protection as well as for food.

José's trust

When feeding he no longer grabbed the banana from my hand and made off with it but gently put his paws on mine and with apparent care to avoid injuring me with either claws or teeth, ate slowly. In short, within limitations, José and I had acquired confidence in one another. Knowing that since he had left his mother's side he had never been touched except with intent to kill, I made no attempt to caress José, nor did I expect anything like a purr or friendly tail-wag from him. To be known when we met away from the laboratory was the extreme form of recognition I expected.

On the morning of March 29 I met him near the lake digging with one foot for tarantulas. He stopped work as I approached and came toward me with an expression which I interpreted as saying: "You haven't a banana about you, have you?" But before I could explain that I had not expected to meet him, etc., he smelled his own reply and returned to his digging.

Two days later, knowing I would pass this way, I placed a small banana in my sack on the chance of meeting José again. Sure enough, there he was hopping down the hill toward me, the injured foot held high. This time his expression read "What about that banana?" and I replied "Well, what about it, José?" He sat there on his haunches waiting for me to make the next move, but as I remained motionless, he came forward, went direct to the bag at my side, extracted the banana and ate it at my feet. He did not ask for another, for he knew as well as I that there were no more. Then he went into the forest but soon returned to hunt grasshoppers about me as though he sensed a safety zone in my vicinity.

His only friend—man

As the time for my departure at the end of April approached, José was returned to his friends at the kitchen door. New fur was sprouting from the bare patches on his body, but he could not hope for a new eye, and I doubt if ever again his foot will serve him as an effective weapon. With our bananas and his discretion he may survive until another mating season brings with it the desire for a mate and forces him to re-enter the lists. Then the loss of a foot, as well as an eye, will prove too great a handicap and José will meet the end of the male of his species. But he will have added to our knowledge of a coati's life. His sisters, in due time, doubtless had families of their own, but since reaching maturity José's only contacts with his kind have been to fight and to mate. Aside from these brief periodic exhibitions of animalism he is alone in his world. In sickness and in hunger he is dependent solely on himself. Other forms of life may serve him as food; with man alone can he hope to make friends.

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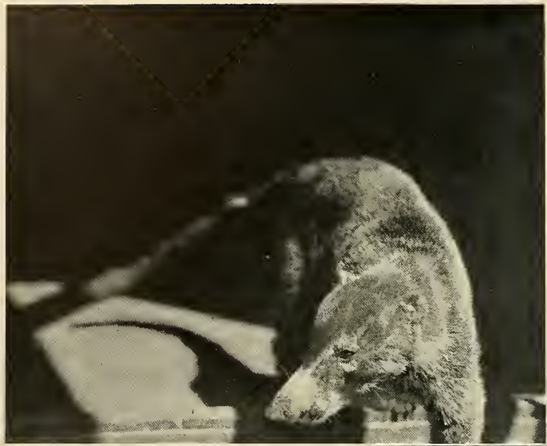
*Since the above was written I have discovered the following in *Science* for June 26, 1936:

"Licking their wounds, a practice universal among animals, has good bacteriological justification, is reported by Dr. Herman Dold, professor of hygiene at the University of Tübingen. Cultures of bacteria to which saliva was added failed to thrive, while untreated 'control' cultures grew flourishing colonies of the germs. It therefore appears likely that in addition to keeping dirt and hair out of their wounds by the constant licking, the afflicted animals are also applying an effective antiseptic."

José



(Above) A portrait of the coati whose intelligent actions have for two seasons entertained the Museum's expedition at Barro Colorado near Panama: a battle-scarred veteran of the mating season, with only one good eye, a defective upper lip and a split left ear

(Right) Breakfast at the author's knee: an expression of mutual confidence

(Left) After seven months of easy living José was quick to resume his training in aerial acrobatics. Here he is shown 'tightrope' walking to the tray which contains his favorite food, bananas

1936

(*Above*) *José is shown circumventing the tree guard which coatis could not pass. José avoided it by coming from above, and walked the single wire to the food tray, a distance of 15 feet*

(*Left*) *Pulling a banana down which is attached to a string thrown over a single wire*

In the picture at the right the single wire to which the banana was tied did not reach the ground, so José climbed out and pulled it up as shown

José's intelligence was displayed largely through his keen sense of smell. If the suspended box shown above contained a banana he would pull it up, but if it held only a stone he made no attempt to obtain it

Complete confidence in man—his only friend: José eating a standing meal at the author's doorway. His left shoulder and forefoot show some of the wounds sustained on his second mating expedition which seriously threaten his chances in the struggle for survival

The Desert Fish of Death Valley

It seemed impossible that fish could exist in a spring in Death Valley, far from the nearest water, but there they were, survivors of the Ice Age

By WILLIAM V. WARD

Could anyone believe that there are fish in California's Death Valley? Hardly; at least no one would entertain for a moment any such thought who had gone, as a tourist, through that sun-scorched furnace-heated region where streams are unknown and where the only pools are those of bitter waters.

Thus, when I read from a newspaper a colossal story of a certain spring in Death Valley wherein live and abound a thriving species of fish, I thought that perhaps the reporter had had a slight touch of the sun. However, the article was written in so reasonable and coherent a style that it gave a suggestion of truth and most certainly provoked curiosity. The newspaper story really was not unduly exaggerated; it merely gave the surprising information that at Saratoga Springs in the southernmost portion of Death Valley, about twenty miles from the lowest point on the North American continent*, there were to be found living in the salt water of that spring, a certain species of small fish. And that was the fact which interested me, and caused me to wonder.

To bring 'em back alive

Being somewhat of a scientific turn of mind, I decided to go at my earliest convenience to Death Valley to investigate these unusual fish and to try to photograph and collect specimens of them. Then, too, perhaps I had in mind exposing as a nature-fakir the writer of that newspaper yarn. So, when time permitted, the trip was undertaken. Food was prepared for a desert camping trip: water jars were filled, fish nets were made, thermos jugs were procured in which to place a few fish in an effort to bring back specimens alive, if any were found; cameras were loaded, and a small special aquarium was taken along in order to obtain photographs of the fish in the field in case it should be impossible to bring them out of the valley alive. Thus equipped, a fishing expedition to Death Valley was under way.

Into the desert

The springs described were found quite easily after a preliminary study of various maps and then, after arriving in Death Valley, by watching for the desert water-hole signposts which have been erected there by the United States Geological Survey. The roads leading to the springs where the fish were said to exist are clearly marked, for the springs are among the largest in the whole Mojave Desert, and they long have been noted as a camping place for desert travelers. Even the Indians had been there, as picture writings on the face of a rock wall a few hundred feet to the southeast testified.

Late in the afternoon, after a long, hot journey across the desert, the car came to a jolting stop beside a circle of reeds, surrounded by salt grass, which marked the location of a water-hole. Stiff-legged from driving, I climbed out, pressed my way through the reeds, and looked into the pool.

Wonder of wonders, if the newspaper story wasn't right! There were the fish! A thousand of them, playing and fighting in the depths of the pool. Slanting rays of light from the afternoon sun reflected themselves from the iridescent blue sides of the males as the fish darted in and out among the reeds and sunbeams.

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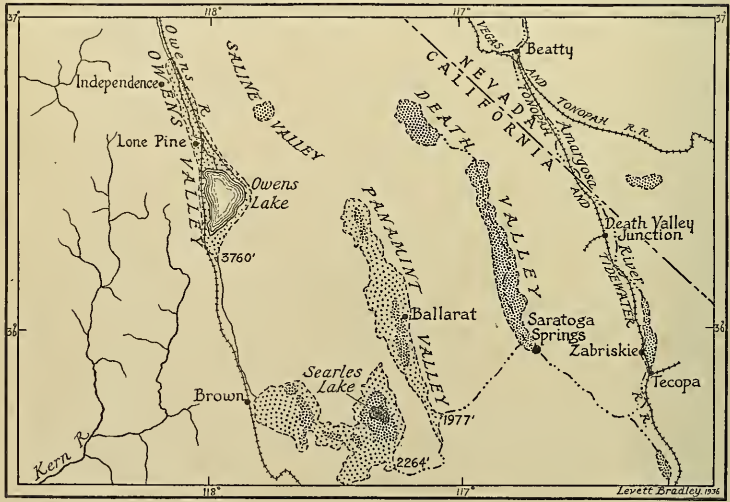
* 276 feet below sea level.

The pool was oval in shape, about twenty by thirty feet, and from two to five feet in depth. The bottom was covered with decayed vegetation except in several round, sandy spots ranging from one to three feet in diameter through which the water bubbled from its underground source. As each new jet of water came in, the sand would shift, rise up in a little whirling pillar and then fall away; and ever among these swirling pillars of sand the fish were darting in and out, evidently merely to enjoy the tickling sensation of the sand.

An investigating glance around the springs showed that the one I was standing near was the central pool from which the water flowed through several small ditches, heavily choked with vegetation, to two other pools each of which was an acre or so in extent. These larger pools were quite shallow and around their edges waded a few killdeer and a Wilson phalarope, while on the surface swam green-winged teal and western grebes. Red-winged blackbirds were at home in the reeds. The larger, shallow pools, together with the surrounding marshes and tangled ditches which connected the several pools, formed a breeding ground for the fish, the small ones of which could be seen swimming in schools close to the surface. Here in the shallow water and among the matted vegetation and algae, the young fish were able to hatch and to grow unmolested, until they were big enough to return to the central pool and cope with their vicious cannibalistic parents.

Looking up from the pools and marshes for a quick glance at the topography, one's eyes met the barren, rocky slopes of a spur of the Ibex Mountains, which border the eastern side



How the Fish Got into Death Valley

This map shows a vanished lake system which probably existed in Southeastern California in the glacial epoch. At that time Death Valley was presumably the overflow basin into which drained the waters from the surrounding glaciers and mountains. The fish are believed to have entered Death Valley by these waters and have survived there in the restricted salt waters of Saratoga Springs, completely cut off from all other waters of the world and only twenty miles from the lowest and hottest place in the United States

The shaded areas were occupied by lakes of the Pleistocene epoch; and the darker shaded areas represent playas, or plains intermittently covered with shallow water. Searles Lake is not a lake in the ordinary sense but occupies a salt-incrusted surface and varies in size

(After Hoyt S. Gale, Bulletin of the United States Geological Survey No. 580)

of the Valley; while to the northward, across the dry bed of the Amargosa, one saw through a haze the snow-capped crest of Telescope Peak as it rose eleven thousand feet above the heat waves which shimmered over Death Valley. Indeed, it was a strange and picturesque setting in which to find fish; so much so, in fact, that it caused me to cease exploration for the moment to determine why the fish were there.

It was clear that they could not have come to these springs from any other pools in the region. The nearest other water was miles away; and an examination of the U. S. Geological Survey water-supply maps for the Mojave Desert showed that it would be an impossibility for the fish to travel between pools even in times of heavy rains and floods. Therefore, it seemed most reasonable to presume, as do Stanford University icthyologists who are studying the desert fish, that the little minnows are descendants of those which once inhabited the area at a much earlier geological period when the desert had a moist and humid climate, and when the present arid basins were lakes and the dry water courses full flowing rivers. Such a time was probably in the Pleistocene when Lake Bonneville and Lake Lahontan covered with fresh water much of the territory in the southwestern United States; and when the Mojave, Amargosa and Owens Rivers connected the present springs, dry lakes and washes in an integrated river system which drained the melting glaciers then on the neraby mountain ranges.* This drainage system is depicted in the accompanying map and diagram.

These fishes of Saratoga Springs belong to the hardy family of *Poecillidae* (killifishes or Cyprinodonts) and are known to science as *Cyprinodon macularius*. They are known commonly as "Death Valley Fish," "Desert Minnow," and "Spotted Pursy Minnow"; and variations of the type specimen are found

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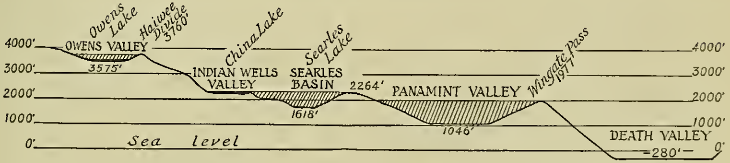
* "Waters that formerly filled Owens Valley until they overflowed, flooding successively lower and lower basins, formed for a time a chain of large lakes in what is now the desert region of southeastern California. These flood waters passed from Owens Valley, the principal source of the water supply, through Indian Wells, Searles, and Panamint valleys, in each of which there was an extensive lake. Finally the waters are believed to have overflowed also into Death Valley, and there the physiographic record has not yet been completely deciphered. . . .

"Panamint Lake narrowed to a point at its south end, and this was not only the point of inlet for the overflow from the Searles Basin but it appears that the inlet was also near the position of its probable outlet or overflow during the period of its maximum flooding. The greatest depth of Panamint Lake was probably determined by Wingate Pass, through which an overflow is believed to have passed for some time into Death Valley. . . .

"The final bit of evidence concerning the maximum water level of the Panamint Lake was found in the contouring and elevations in Wingate Pass, which leads from the Panamint Valley into Death Valley. These data were obtained in recent surveys for maps now in preparation. . . .

"The correlation of the Quaternary lakes of Owens Valley and similar areas in the Great Basin with the stages of ice extension in the glacial epoch rests upon general considerations, although it is accepted by most geologists. . . .

"It is stated that the greatest expansion of the waters of the Mono Basin occurred subsequent to the last extension of the Sierra Nevada glaciers. It is reasonable to assume that the other lakes of the Great Basin attained their maxima at the same time." (Hoyt S. Gale, in *United States Geological Survey, Bulletin 580*, "Salines in Southeast California," pp. 251-323.)



Death Valley at Foot of Former Lake System

The isolated fish which live in Saratoga Springs in Death Valley are believed to have come at a time when a more humid climate connected the basins shown here in profile into one system

(After Hoyt S. Gale, Bulletin of the United States Geological Survey No. 580)

in desert water-holes throughout the Southwest. "Death Valley Fish" seems to be quite appropriate for the specimens at Saratoga, for no other fish are found in Death Valley. They attain a maximum length of from two to two and one-quarter inches. The males have slightly barred sides which become a brilliant iridescent blue when the light strikes them at the correct angle; but at other times they appear to be plain gray, with sometimes a reddish-brown tinge when one is looking down at them in the pool. The females lack most of the iridescent blue and are a little paler than their mates, while they have vertical bars on their sides which are much more prominent than those of the males. The fish are omnivorous, eating both vegetable and animal foods. This is apparent to the observer who watches a group of them carefully eating the algae off some plants at the bottom of the pool, and then sees them make a lightning dash to the top of the pool to make short work of an unfortunate moth which chances to be blown into the water.

How to catch them

It was necessary to catch several fish for photographic purposes as well as to obtain a few to attempt to bring home for aquarium specimens. The rapidity of movement of the fishes in the water made it almost an impossibility to even try to scoop them up in the nets brought for the purpose. However, the easiest way to catch them soon was discovered. An insect would be placed on the surface of the water, and its struggles quickly would attract a number of fishes. While they were busy attacking the insect, the net would be slipped quietly beneath them and they would be captured. Then they were transferred to a waiting thermos jug to be carried home, or else placed in a small aquarium, the front and back walls of which were close together so that they would be confined in a narrow plane while their photographs were made. It was but a matter of a few more minutes to catch from eighteen to twenty fish of both sexes and of various sizes and to place them in thermos jugs for the trip home. Five or six more were caught for the purpose of making their pictures. The small glass aquarium was made ready and the fish placed in. Afraid at first, they made fairly good camera subjects as soon as they had thoroughly investigated their new surroundings and had settled down a bit.

In sweeping the nets about the pool, it was found that fish were not its only denizens. A brown leech, of about four inches in length, was rather common, as was the yellow-bordered water beetle, *Dytiscus*. The water beetle, apparently, was the only enemy of the fish aside from the frogs. It was seen swimming constantly along the edges of the pool searching for young fish which it kills by clasping them with its strong fore-arms, while its proboscis pierces the fish's back to suck its blood.

Temperature of the water at Saratoga Springs was found to be quite high, ranging rather closely between 82 and 83 Fahrenheit, and to maintain that temperature consistently, as it is a warm spring. No doubt the temperature of the surrounding shallow pools, which are away from the source of warm water, fluctuates quite widely as does the air temperature from night to day and summer to winter. Death Valley is one of the hottest regions in the world. The minimum daily temperature in summer is rarely below 70° F. (in the shade); and the maximum may, for days in succession be as high as 120°, and the U. S. Weather Bureau has recorded an extreme of 134°. But even though the fish might be used to wide temperature changes it was deemed most advisable to transport them the three hundred miles out of the desert in thermos jugs in order to maintain a constant temperature; and in that manner all of the specimens arrived home safely.

As aquarium pets

The fish have made most interesting aquarium specimens for well over a year. Some have lost their lives through their very ardent pugilistic activities; but much of this is avoided by keeping the aquarium thickly planted. Temperature variations seem to cause no great harm other than a loss of color and vivacity. They still live in water brought from Saratoga Springs, but this has been diluted with an equal volume of tap water, thus considerably reducing the alkalinity and salinity. One looks at these little minnows pushing their way determinedly about the aquarium and knows that they are "tough" fish, as well they must be, to have survived since the ice age in a little pool in Death Valley only twenty miles from Bad Water, the lowest and hottest place in the United States.

The Desert Fish of Death Valley

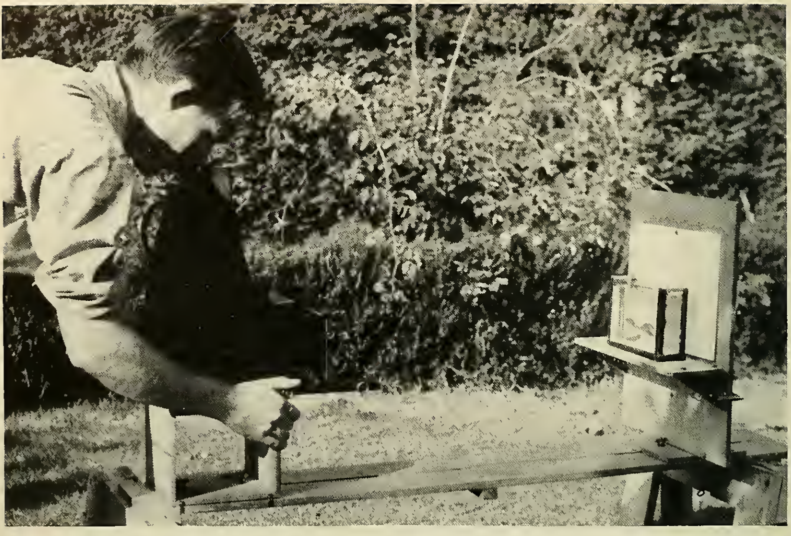
Death Valley, the lowest, hottest region of the United States, might not seem a likely place to find fish. Yet the salt pool shown below is the breeding place of myriad finny survivors of the Ice Age

(All Photos by William V. Ward)

(Left) Collecting aquarium specimens of these cannibalistic fish with bait, net and thermos jug. Insects must be placed on the water to hold their attention long enough to slip the net under them

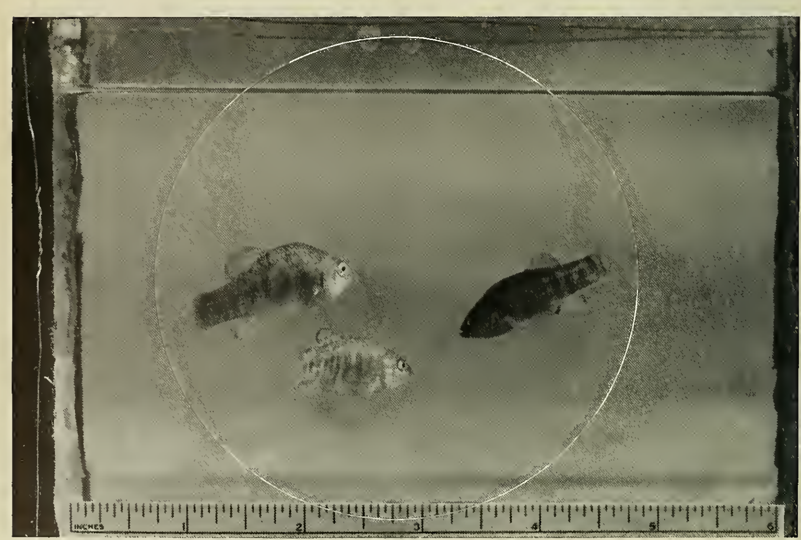
From the shallow, marshy pools where the fish hatch they swim into the central pool shown below to wage their struggle for existence with their cannibalistic parents. It is believed that they are survivors from the Glacial Age, when the desert had a moist climate and fresh water covered much of the territory in the southwestern United States

The captured specimens were put in a thermos jug, which was later found unnecessary, as the fish are so hardy as to need no temperature protection



Photographing specimens of the Death Valley fish. A special aquarium was used in order to keep the fish in focus and to obtain true-size pictures

The Death Valley fish (Cyprinodon macularium), *about three-quarters life-size. The females (left) have prominent vertical bars on their gray sides, while the male (right) is a brilliant iridescent blue with faint vertical bars*



The Tragedy of the Culbin Sands

An amazing catastrophe which changed a section of the fair Scottish countryside into a miniature Sahara and made time stand still for more than two centuries

By H. MORTIMER BATTEN

IN the autumn of 1694 there occurred at Culbin, on the Moray Firth, midway between Nairn and Forres and just where the wonderful and varied River Findhorn joins the sea, one of the most curious calamities which has ever occurred in Scotland. Curious yet tragic, for in Great Britain one hardly expects the overwhelming forces of Nature to make themselves felt.

One autumn afternoon a wind sprang up from the sea bearing with it the sting of flying sand. Little was thought of it, for in spite of the wonderfully mild climate of that area of Scotland, which lies open to the sun yet is sheltered from the cold winds by the Grampian Mountains, autumn storms which piled up sandhills and caused the sea to make great inroads into the coast, were not unusual. As the wind strengthened, however, the sand thickened, and its onslaught became so fierce that laborers in the fields were compelled to leave their ploughs in the half-cut furrows, where many of them remain to this day.

The storm rises

As night came on, the fury of the storm passed all records. It was then that some of the villagers recollected that some days previously an old woman, supposed to possess the powers of witchcraft, had visited the village in search of charity which had been refused from door to door. On finally leaving the village she breathed a curse upon its inhabitants. The fear of a witch's curse was strong in Scotland in those days; in fact, less than a century ago, such powers went unquestioned, and even today there are many who shrink in terror from the curse of an old woman, just as there are many who would go far to obtain for their children the blessing of very old people.

That night the fear of being buried alive descended upon the inhabitants. The sand clouds were beating in waves upon the village, so that fishermen's cottages, the laborers' dwellings, and the improved grounds surrounding the fair barony of Culbin were rapidly becoming drifted over. At midnight the villagers fled. The young Laird with his wife and baby made their way out of the storm-stricken area with the rest, and one can picture the procession, for in those days there was no way of spreading information as to the kind of calamity which had befallen them.

The Laird and his wife found refuge at Earnhill, but next morning the storm had abated and the villagers returned.

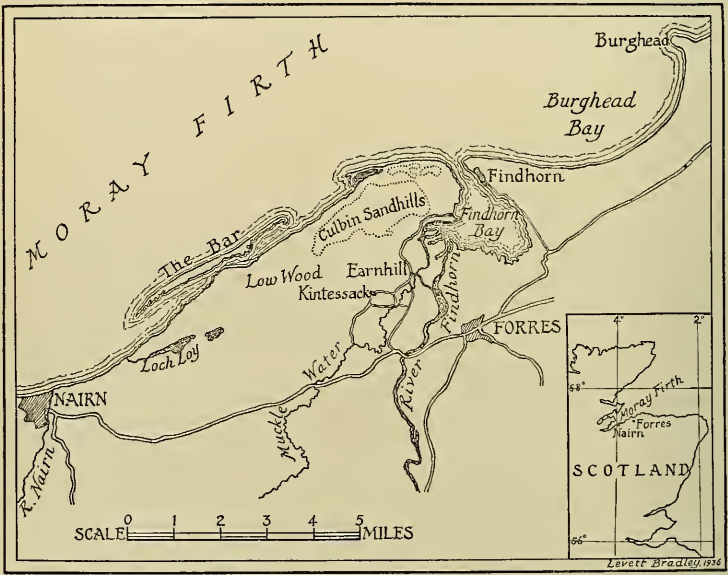
The village buried

They found their cottages covered, only the roofs and chimney pots showing, but by digging down they managed to release their horses and cattle, which were then driven inland. That night the storm recommenced with double fury, and next morning not a vestige of the village was to be seen. Millions of tons of sand buried the houses, and sweeping far inland was a vast and tumultuous desert of sand. To the people of Culbin it was incredible that this vast accumulation, built up in a few hours, could have come by the ordinary course of things. It was said by many that the depths of the sea actually disgorged the sands, and naturally all kinds of rumors and superstitions were current for many years.

The Mansion House of Culbin was, it seems, a square building standing on level ground, surrounded by its garden and grounds. The immediate lands were rich and profitable, for the area was known as the granary of Moray. Adjoining the house was a stone-built dovecote, the privilege of the Barony, but now all was irrevocably buried and lost to man's tenancy. The Kinnairds were practically ruined.

The following year the young Laird applied to the Scots Parliament for a release of land tax on the grounds that by an act of God two-thirds of his estate had been destroyed. Parliament granted the relief sought, and at the same time passed an act prohibiting the pulling of bent, juniper, and broom, the binding roots of which help to make the sandhills permanent. The act is still in force. And one of the most interesting planting schemes is at present in progress in order to fix the dunes to prevent the sands working further inland. Marram grass is planted at short intervals, and other plants, such as *Carex arenaria,* which have strong, running roots, have at last obtained a hold on some of the more dangerous slopes. Corsican pine, Sea Buckthorn and grey alder are systematically set by the foresters, who are ever watchful for dangerous "blow outs" which might result in wholesale movement. In stormy weather it is unsafe to penetrate the area. Many lives have been lost there, and in very few instances is the body recovered.

The remainder of the story of the Kinnairds, succeeding their midnight flight from Culbin, is a sad one. Apparently the Laird and his wife lived in poverty, and both died a few years later. The little boy was taken charge of by a faithful old servant, who journeyed with



A Small Sahara in Scotland

The dotted lines in the above map mark the once fertile section of Scotland which a two-day storm in 1694 buried beneath millions of tons of sand. The area has ever since remained a barren waste of shifting dunes. In stormy weather it is unsafe to venture into it. Many lives have been lost there, and rarely is the body recovered.

him to Edinburgh, where she earned money for him and herself by her sewing. The boy passed into the regular Army, and it is strange that it should have been left to Ireland to recognize him. He obtained a captaincy, but died young and unmarried.

For a hundred years there was no record from the desert area. The sands sighed and the wind moaned, a region forsaken by man and utterly worthless. Then one day the roof of the old Mansion House appeared like a ghost from the shifting, drifting area. There can be no doubt about this, for workmen were at once sent to carry away the most valuable stone work, but its reincarnation was short, for in a few days it was again swallowed up in the ever-moving desert.

A living tree

Until recently there lived an old man who told how one day an apple tree was revealed from a corner of the Culbin House orchard. In response to the daylight it promptly burst into blossom which quickly matured, as though the tree were giving forth its best to propagate its kind, but the sands closed again, and it was lost.

The Culbin sands are forever shifting. The faintest eddy of wind sends sand-storms scudding across the white glitter, and a real wind entirely alters the lay of the country in a single night. Even on a still day the sands are continuously creeping; but the silence is absolute. There is no droning of insects, no song of birds, or rustle of leaves. Such timber as exists is stark and leafless. Overhead the sky is of the clearest and most intense blue, and if from the crest of the sandhills one overlooks the surrounding wold country, the fields and woodlands are endowed with a richness of coloring unrivaled elsewhere. Only on the dullest days does the sky darken overhead, and while the sands are yellow after rain, they are normally of pearly whiteness. In some lights the desert is overhung with a golden glow which seems to emanate from the sand, and I am told that when darkness gathers, the surroundings are apt to assume an unearthly purple stain, such as is sometimes seen over the Arctic snows. One of the most curious features of this land is that distance cannot be measured by eye. A companion fifty yards away may appear as a far distant figure; a slope rising almost from one's feet may appear on the remote skyline.

For centuries the port of Findhorn carried on an active export with England and the countries of continental Europe, and the interest of this extraordinary region is enhanced by its historic relics. Industries which required a high degree of skill were carried on over the area now obliterated, and when the winds lay bare the naked soil, the hoof marks of cattle and even the imprints of man himself are found as clearly impressed as on the day they were made. In the Edinburgh Museum there is an immense collection of flint arrow-heads, saws, scrapers, and knives, taken from the Culbin area. These have been picked up by casual collectors during the past fifty years, but by no means are there signs of the supply becoming exhausted. Anyone visiting the place is sure to find such relics. Numbers of articles of bronze manufacture have also been found, rings, rivets, studs, and pins, also crucibles and molds of stone. A beautiful bronze armlet of ancient Celtic pattern was recently discovered, also a small penannular brooch, one of several, was picked up by a lady, while another lady found a massive bronze finger-ring and a bronze spear-head.

Historical relics uncovered

I saw a collection of coins made by one who had visited the region for that purpose. They were extraordinarily varied, being of Roman, French, English, Scottish, and Flemish mintage. The coins range from 21 B.C. to the time of Charles II. With one exception there have been no known discoveries of treasure. At one time, a laborer working near to the area of the sands, found a bag of silver coins. They proved to be pure silver of the highest grade, and the man at once hid his find from his fellow workmen. That night he and his wife returned for the money, and from a laborer he became a farmer of some standing. His story, of course, leaked out, and some of the coins were traced and duly identified.

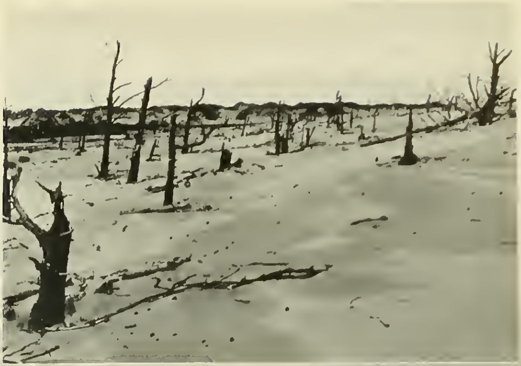
For all the lifelessness of the Culbin sands, the surrounding country is rich in bird and plant life. Sea birds of many kinds haunt and breed in the wild region where Findhorn joins the sea. Water plants of many varieties abound, and the Findhorn valley, so dearly loved by Charles St. John, is, from the mountains to the sea, one of the most varied and remarkably beautiful in the British Isles.

The Tragedy of the Culbin Sands

A Historic Catastrophe in Pictures by H. Mortimer Batten

In 1694 a witch's curse was followed by a two-day sandstorm which completely buried the fertile Scottish barony of Culbin. The accompanying photographs show the scene of this astounding calamity as it appears today

After fleeing by night to avoid being buried alive, the villagers the next day found only the roofs of their cottages showing, and had to dig to release their imprisoned cattle. A day later not a vestige of the village remained in sight



Stark, leafless timber: once an apple-tree thrust out and blossomed in the sun; then the ever shifting sands closed over it, reclaiming their own

A sudden wind will entirely alter the landscape overnight

To be caught in a storm in this small Sahara is extremely dangerous

On a still day the silence is absolute. There is no droning of insects, no song of birds, or rustle of leaves; and distances are strangely deceptive

Beneath the millions of tons of sand lie plowshares abandoned in their furrows and innumerable historic relics, many of which have been found by collectors

Your Treasure-House of Jewels

A review of "The Story of the Gems" by Herbert P. Whitlock, a handbook to the position of precious stones in Nature and in human life and philosophy

By GEORGE C. VAILLANT
Associate Curator of Mexican Archaeology, American Museum

MR. WHITLOCK, Curator of Minerals and Gems of the American Museum of Natural History, has had to combine in his professional work, the bleak research of a pure scientist, the joyful acquisitiveness of a collector, a professional appraiser's canny skill in evaluation, and the aesthetic sensitiveness of a connoisseur of lovely things. The joining of these varied points of view goes to make *The Story of the Gems** far more than "A Popular Handbook" as his subtitle modestly states, but rather a delightful description of the meaning of the author's Hall in the Museum, revealing as many planes of interest as the more intricately cut of his treasures possess facets.

Written for the layman

The plan of the book is broadly and logically conceived. An introduction defines gems and explains the reasons for their value. Then follows a chapter on the history and development of jewelry with emphasis on precious stones. Since the appreciation and esteem for such objects on the part of Man have caused him to direct much inventiveness and technical skill to their preparation as ornaments, Mr. Whitlock gives two fascinating chapters on the art of the lapidary and the methods of cutting precious stones.

Having laid down a basis for the appreciation of gems, the author describes the chief groups of precious stones. The diamond well merits its two chapters, the second of which describes the most famous stones of this class. Another section covers rubies, sapphires, and emeralds. Two chapters describe semi-precious stones like topaz, tourmaline, spinel, and zircon; and chrysoberyl and opal are considered apart, as semi-precious stones that have advanced into the precious grade through intrinsic beauty and popular demand.

The quartz gems, rock crystal, amethyst, onyx, and the like, are placed in a special category since not only are these substances used as jewels but also in small objects involving artistic as well as technical skill in manufacture. Opaque gems like turquoise and lapis lazuli and a number of less known varieties have a chapter, as does deservedly jade. A chapter on unusual gem stones opens delightful possibilities for ornament, and the final chapter is devoted to such organic products as pearls, amber, coral and shell, all of which have been used as jewelry. A bibliography, a descriptive table of gems and an index complete the volume.

Handsomely illustrated

The illustrations are excellent. First and foremost is the frontispiece, a double page in colors, presenting twenty-four jewels. The play of light in these superb specimens is so faithfully reproduced by the artist that one almost seems to behold the actual gems. Judicious use is made of photographs, illustrating not only the chief treasures of the Morgan Hall but also the technique of preparing them. A lucid series of diagrams aids vastly in the understanding of the types of gem cutting.

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* *The Story of the Gems,* Herbert P. Whitlock, pp. ix, 206, illustrated. Lee Furman, Inc., New York, 1936. $3.50.

This outline gives the summary of a competently prepared handbook, but the *Story of the Gems* contains much more than the description, analysis, and appraisal implied by such a volume. Mr. Whitlock, by the use of anecdote and observation, by the heading of his chapters with astutely selected quotations, brings out constantly in his pages the relation of man to the stones he considers precious. He places as much stress on the aesthetic values of his subject as he does on the scientific, nor does he fail to lay due emphasis on the technical considerations of craftsmanship.

This approach brings out very strongly that there is far more to the appreciation of precious stones than a knowledge of their mineralogical rarity or their market value. In fact, to some of us the cost factor has become so overwhelmingly important that the intrinsic value of gems has been obscured by the ignoble one of extrinsic or commercial worth. In the Fine Arts, heavy as is the shadow cast by the astronomic prices of masterpieces, it is not yet able to dim their genuine intrinsic value to a public educated by school and museum to the appreciation of craftsmanship and aesthetics.

Yet it is rare to find an individual so absorbed in the subtle refractions achieved by the inherent beauty of his stone enhanced by the skill of the lapidary, as that same individual would be in a painting or a sonata. One might almost draw the grotesque analogy that if the public attitude to the fine arts were like its appreciation of beautiful gems, we would find on great occasions like the opening of the opera season people parading like sandwich-men placarded front and rear with masterpieces of Italian and French art, or else laboring their heaving way beneath an ancient Greek statue, vying as to whose was the heavier or more complete.

What makes gems valuable

Mr. Whitlock, however, shows very clearly why the major gem stones occupy their supreme position among jewels. Their supremacy is due to their qualities of color, hardness, transparency, and refraction of light, and not to the machinations of middle-men and super-salesmen. Fashion, of course, as in every other aspect of human life, plays its part, and to some the delicate carving of the emerald from Delhi might seem a sacrilege, since brilliance was sacrificed to graphic design. Certainly few stones can compare with the "Star of India," the sapphire that is queen of the Morgan Hall.

Such treasures are for the few. None the less there are marvelous effects to be attained and pleasures to be derived from the use of lesser stones, which because of fragility or lack of high refraction cannot take their place with the major examples of the diamonds, sapphires, and rubies. It seems such a waste to see worn in every American community those sad little diamonds, symbolizing all our social striving, when for the same cost a rich and satisfying gem like a topaz or an opal could be obtained.

Beauty not always costly

A visit to the Morgan Gem Hall, one might almost say to Mr. Whitlock's treasure house, offers infinite possibilities for the gratification of one's most lusty craving for personal adornment. The wide variety of minerals—precious, semi-precious, and common—present possibilities for jewels which, unlike diamonds and rubies, are not, in the strictest sense of the phrase, kings' ransoms.

The late Dr. George F. Kunz called attention to the possibilities in this direction but without success in diverting public taste to a more abundant source of supply. To be sure there was some innovation in utilizing as gems stones whose value was enhanced because of their scarcity. The wearing of inexpensive but handsome stones has a further application in these days of brigandage, no less severe if more furtive than in days gone-by. It seems highly unenterprising to wear imitations of known gems when it is possible to explore fresh fields of beauty, or even to return to more primitive days when lesser gems set in relation to their settings made adequate ornament without stressing the absolute value of the stone.

Mr. Whitlock, however, gives an additional reason, Romance, why the major stones will always keep their allure. Gems are indestructible, and by changes in cut and in setting a famous stone may pass through a varied, at times bloody, history. There is a peculiar fascination in speculating as to what extremes of human cupidity governed the successive ownership of the diamond in one's ring.

A handbook is not expected to appeal to all types of interest, but the *Story of the Gems* almost reaches that goal. The problem of presentation in a handbook is very much the same as that in preparing a Museum exhibition. The book and the hall ideally should interest as well as instruct, and both must therefore be capable of touching at some point the most extreme reaches of human social experience.

Mr. Whitlock's use of quotations to introduce each phase of his theme, is a delightful means for bringing his subject within the range of the layman. Thus before describing the famous diamonds of the world he quotes from Pliny:

"The greatest value among the objects of human property, not merely among precious stones, is due to the adamas [diamond] for a long time known only to kings and even to very few of these."

Jade through the ages

This description tallies very well with the impersonal quality of the precious stones. The chapter on jades, however, is prefaced by an observation of Confucius', "In ancient times men found the likeness of all excellent qualities in jade." The all too brief chapter on this singularly subtle carving of a stone that ranks as precious in the East and in pre-Columbian Central America, but in the Western World does not attain jewel quality, becomes invested with the pervasive charm of the East.

In the case of jade, one enters the field of what might be called subjective jewelry, since the chief pieces of carving are meant to be contemplated by the owner. In contrast to jade, diamonds and the like have an objective quality, for they are worn as much to impress others as to give the wearer direct satisfaction in their mere possession. Whereas technical consideration of workmanship enhances the brilliance of a jewel, it takes a consummate artist to create a lovely jade.

The intricate patterns used to ornament Chinese bowls, boxes, or vases, retain in outline a gracious purity of line. Goddesses, gracefully poised, show the various qualities of character possessed by the divinity. Jade is as beautiful to touch as to see, and indeed the Chinese had special pieces to finger, so greatly did they appreciate the cool contours of this precious stone. The ancient Mexicans, too, esteemed the jade above all other minerals and it is tempting to think that it is an old folk-memory of their Oriental origin.

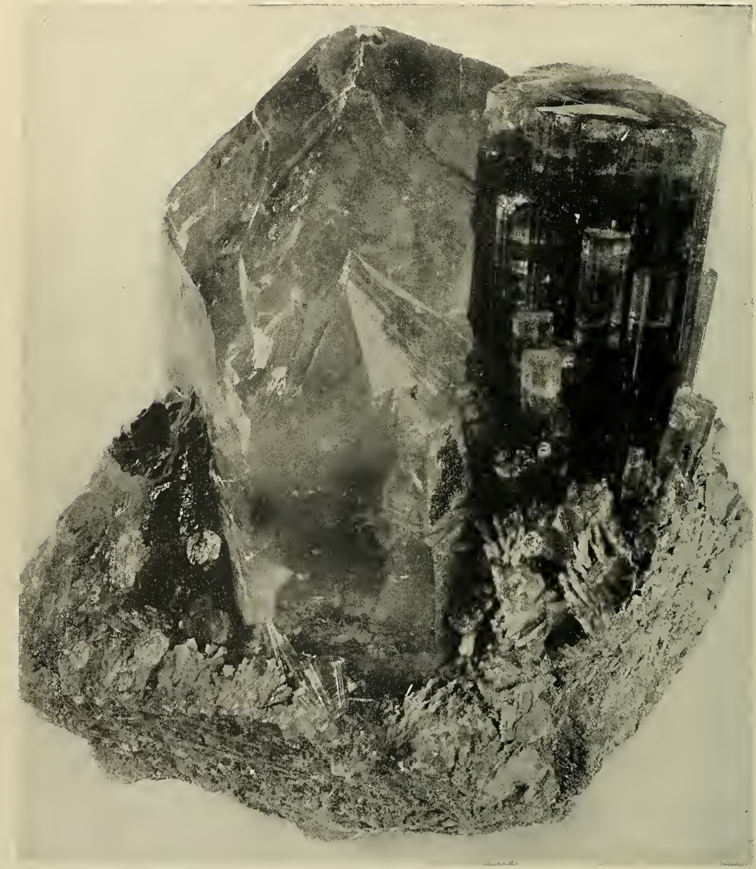
Between the gems and the jades there is apparent a conflict in standards of value. A flawless diamond is a work of nature dramatized by man's technical skill in revealing the innate properties of the stone. A master jade from China is precious not only because of its color but also because of the work of the sculptor who, in transforming the stone to a work of art, creates its highest value. In other words, in jade, art transcends the natural product. The early craftsmen of past civilizations were too concerned with finding means of subduing Nature and constraining it to their benefit, to be overly interested in preserving natural substances for their beauty. True they recognized some stones as more beautiful than others, but they used them as graded elements of a necklace, or in a setting, or as a substance to be carved. Natural products at first had to be subjected to human use, before they could be considered in terms of their own position in Nature. To the art historian, this primitive jewelry is more attractive than stones cut and set simply to enhance their natural properties. Yet these technically advanced methods of modern man reflect, perhaps, his lofty conception of the universe, which recognizes the limitations of man in the face of Nature.

A book for every one

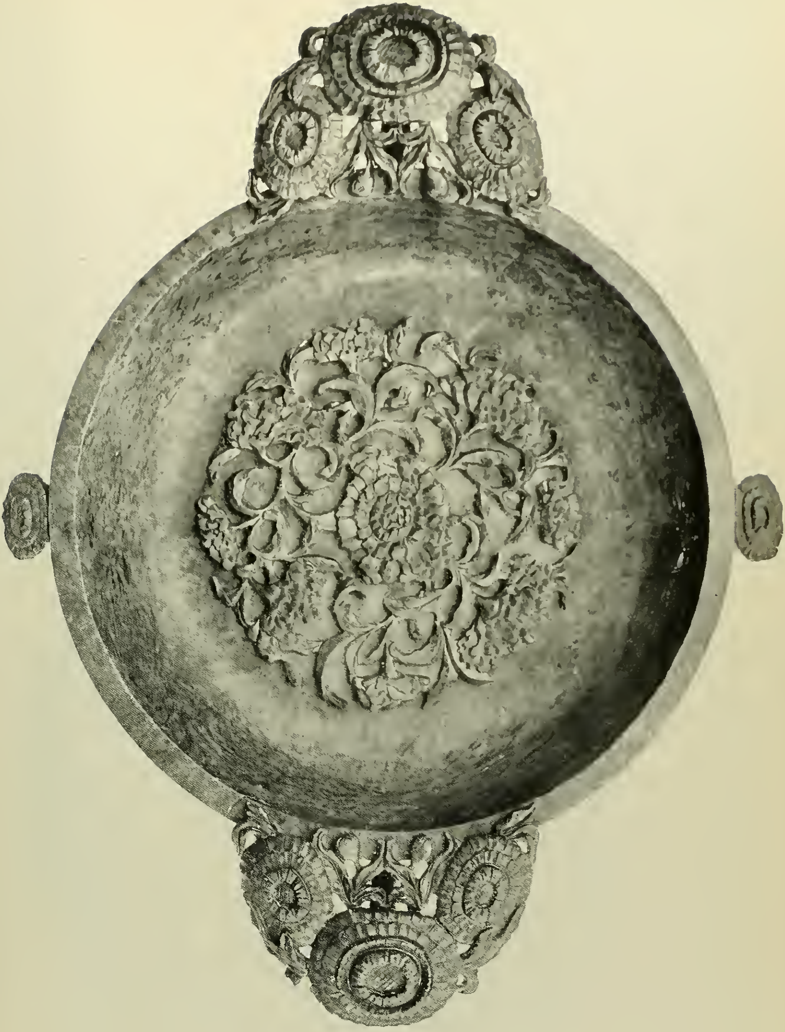
However, whether one be an aesthete, a craftsman, a mineralogist, a Marxian political economist, or better, someone with an open interest in the world around him, he will find that Mr. Whitlock has indeed told "The Story of the Gems," and has preserved a fine balance in the actual subject-matter as well as in the various aspects under which precious stones may be considered. Mr. Whitlock has, in simple language, made a complex subject intelligible, and he has set a standard worthy of emulation in all departments of the Museum, for the explanation of his Hall. It is easy to list and to explain specifically, but Mr. Whitlock has made it possible to see not only why it is of interest and advantage to have a mineral hall, but also why it is so essential to have collections displayed illustrating the physical basis of every subject. Mr. Whitlock has done us all, Museum visitor and Museum employee, a great service in his charming exposition of so fascinating a field of knowledge. He should receive our heartiest congratulations.

Your Treasure-House of Jewels

A selection of photographs from the new book, "The Story of the Gems," by Herbert P. Whitlock

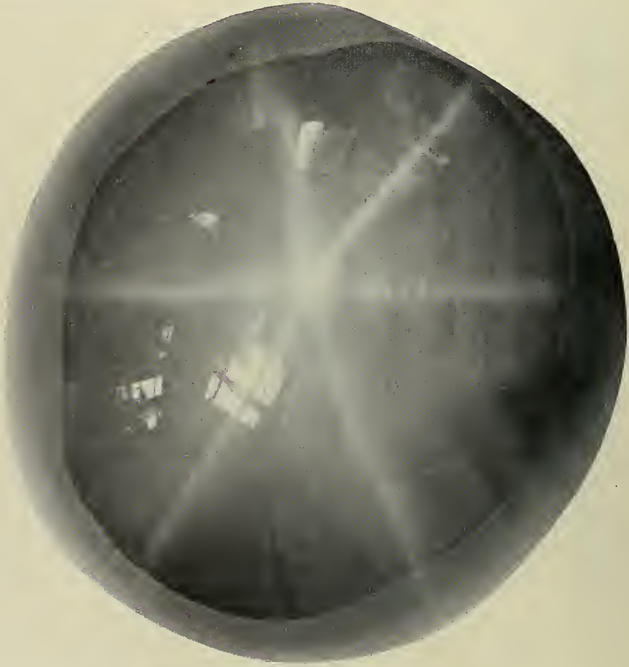


A group of gem crystals of tourmaline (rubellite) with quartz from Pala, San Diego County, California. These magnificent crystals are typical of the triangular tourmaline prism



A large bowl carved with a design of chrysanthemums from spinach green nephrite. This fine carving represents the work of the Chinese jade carvers of the last century

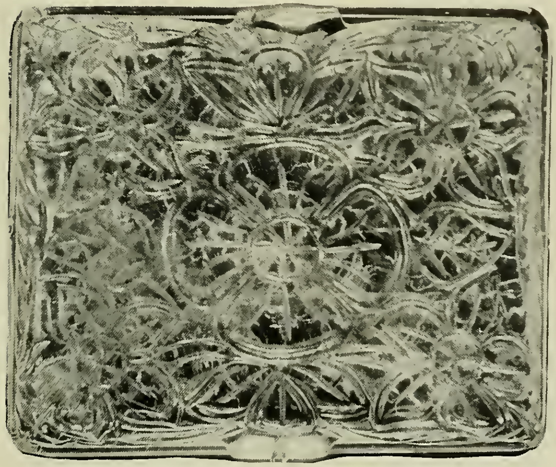
With its 444 perfectly proportioned facets the blue topaz shown in the photograph at the left is a marvelous expression of the art of the lapidary



The "Star of India," the largest star sapphire gem known to exist, weighing 363 1/3 carats (Enlarged 3 times)

A figurine representing the "Goddess of Mercy" carved from Tibetan turquoise by a Chinese lapidary

The Schlettler Emerald: an 87¾-carat example of 16th century Delhi engraving. This stone, as well as the "Star of India" on the preceding page, is reproduced in color in "The Story of the Gems" *(Here enlarged 3 times)*



Mystery Animal

When no reasonable explanation could account for the killing of sheep and deer throughout New York State, a devotee of NATURAL HISTORY took up the trail to identify this mysterious predator

By FRED STREEVER

WOLVES, native to the Adirondacks, vanished from New York State during the last century. In my own County of Saratoga the last one of public record appears to have been killed in 1817 and a bounty of $10.00 collected therefor, though some scattered individuals persisted in the North Woods for many years more.

Rumors of a recurrence began to float about in hunting circles about 1930 and were followed by more or less circumstantial newspaper accounts of sheep, pigs and calves being killed all over the state, and in 1933 our County Board of Supervisors replaced the antique bounty of $10.00, at the same time declaring a night quarantine on dogs, which were suspected.

Dogs or wolves?

In the opinion of most hunters and trappers familiar through forty years of winter hunting on snow, where every trail is scrutinized and its maker identified, the stories of wolves were unbelievable. And when various pelts were turned in for the bounty we were not surprised to find one after another of them were pelts of "police dogs," some of whom showed signs of having been but lately divested of their collars.

All this talk of wolves seemed merely nonsense to me and comparable to the occasional panther stories still recounted beside the deer hunters' bivouac fires. "Where would the wolves come from?" said I, "with none south of the St. Lawrence River for over fifty years past?"

But one afternoon in mid-December, 1935, one of my friends called from the Court House where the Supervisors of Saratoga County were then in session and said they'd like me to say what I thought of an animal that had just been brought in for wolf-bounty. On the way I decided to avoid calling some good citizen a misguided nut who had killed another dog by saying that no identification short of dissection at the American Museum could be considered as positive.

Wolf!

The animal had been killed within a few hours and was not quite cold. He lay on the floor in the hall. There was quite a crowd around him as I came up the stairs, and somebody was saying, "He's a wolf all right." That riled me a little, and I had just got my mouth open when I noticed the short tail. Of course, that typical wolf brush was only a coincidence, I told myself; but the darn thing *was* higher at the withers and lower in the quarters than any dog I ever saw. I took a look at his feet (fur between the pads), and at his coat (dense fur underneath and mixed gray in color). Then they uncovered his mask: a slant eyed, sharp muzzled, curved tusked mug. And overboard went my caution.

"You can send him to Cornell or New York," said I, "for I think they'll want to see him; but for me, I'll go on record right now. It's a wolf!"

The pinch was, where *did* he come from? And if this was a wolf, there almost certainly must be others.

For me the wolf mystery thereafter remained in *status quo* until one snowy day in

January when our red fox chase with the hounds ended prematurely in the Grafton Mountains (across the Hudson River from our home). We were motoring back through the north end of the Luther Tree Plantation, an almost impenetrable thicket some 12,000 acres in extent of evergreen trees ten to twenty-five years old. In 1918 this had been the scene of many successful red fox chases both summer and winter, but the planted trees' growth had been increasing and the red foxes had about disappeared, so we had done no hunting there of late years. A new fallen snow presented its clear record of the ramblings of the night before, a maze of bunny tracks, a few grouse trails, a woods gray fox.

Strange tracks

And then we found what we were looking for but hadn't really expected to see. Strange tracks! As large as a dog's but with a more elongated footprint. Most interesting of all was the course of the trails, which as any woodsman will know determines his findings as much as does the footprint itself. A dog or even a fox would have sought the woods path for less obstructed travel but these tracks threaded the densest thickets.

During the remainder of January and early February, 1936, I tried at various times to get my older foxhounds to take the cold trails of the mysterious beasts on the Luther Plantation. Conditions were not of the best. Snow lay very deep and the hounds could do little but wallow through the thickets. Old Rambo, in his fourteenth year, seemed willing, but being a tremendously heavy hound he sunk so deep that little more than his head was above the snow, and progress was negligible. Some days we could not find a trail, nor was the weather often suitable. Late one cold February afternoon old Min, nine years old, trailed and found something or other that caused considerable and noisy excitement on her part, but before our snowshoes could get us over the three-foot snows to the scene, Min had changed her mind about it and thereafter refused the trails. We saw none of the beasts.

But we had come to the conclusion that there were five different individuals and that the range of the animals differed from day to day. They were in a different place every day but always in about the densest cover to be found. There appeared to be two females and three males, one of which was much larger than the rest.

Finally we decided to try some of the younger and perhaps less choosey Walker hounds from my Rafinesque Kennels, near Troy. So we drove down and brought back Keene, Penny, Shotgun Joe and Red Tugwell and waited for better weather.

The Museum is consulted

Meanwhile feeling that our evidence pointed definitely towards wolves in our local hunting grounds we wrote to the American Museum of Natural History and received the following prompt reply from Dr. H. E. Anthony, Curator of Mammalogy:

> AMERICAN MUSEUM OF NATURAL HISTORY,
> New York,
> February 28, 1936.
>
> Dear Mr. Streever:
>
> Your interesting letter of Feb. 27th arrives at a very opportune time. I have just today written a long letter to Mr. W. Winters, Acting District Game Protector, Saranac Lake Division, regarding the presence of canines in the Adirondacks.
>
> For several years now the Museum has been in touch with several of the Game Protectors in that region and with certain interested individuals in the attempt to secure a series of specimens to work out the ancestry of the packs of dog-like animals which are running at large, killing game, and behaving as wolves.
>
> There have been no wolves in the Adirondacks since the close of the last century. When these marauding canines were first reported they were said to be wolves, but when specimens were received at this Museum and at the Biological Survey in Washington, they proved to be either feral dogs or coyotes. The coyotes arrived in the Adirondacks as escaped animals and did not come into the region under their own power. The dogs, which seem to be predominating elements in the packs, are large animals, either police dogs, collies or shepherd types. Apparently the coyotes run with the dogs and the interesting point at issue is whether the two animals have crossed and there are now hybrids in the packs.
>
> I have examined specimens which combine the characters of these two animals and the evidence seems to be best disposed of by assuming that we do have hybrids. An argument against this is the lack of adequate observations demonstrating that the two animals actually do cross. There seems to be no doubt that the escaped coyotes in the Eastern States, lacking their own kind to run with, take up with wild dogs, and this condition has been reported from several Eastern States.
>
> I am very much interested in acquiring additional material and would be very glad indeed to have skins and skulls of any of these canines you may capture. . . .
>
> Regarding your question as to whether a dog

may be distinguished from a wolf, my reply would be that since dogs are lineal descendants of wolves, the dividing line between large, primitive type dogs and wolves is poorly defined; that is to say, there are very few characteristics to distinguish a husky dog from a pure-blooded wolf. As one encounters the highly developed breeds of dogs, there are very obvious differences which enter into consideration and it is easy to separate the dogs from the wolves. There are certain cranial characters which make it possible to separate coyotes from wolves and from their lineal descendant, the dog, but the Adirondack animals have displayed several very confusing blends of these characters, and I am glad to learn of your interest and offer to send us material which will be valuable to get at the facts. . . .

Very sincerely yours,
(Signed) H. E. Anthony,
Curator of Mammalogy.

Something more than dogs

Closely following Doctor Anthony's response came a letter from a kinsman of mine who is District Game Protector of Saranac Lake Division in the upper Adirondacks. Ray Burmaster always speaks his mind, and on the matter of whether these disturbers were feral dogs or not Ray had few or no doubts. His letter follows:

State of New York,
Conservation Department,
Saranac Lake, N. Y.

Dear Fred:

. . . I am not surprised . . . that you are finding some of these so-called mystery animals down there. . . .

The way it started up here is as follows: For a good many years I have received information from the natives living in the Town of Belmont in the vicinity of the headwaters of Trout River about wolves being up in there. Every once in a while some guide would come in and tell me about hearing them howl. Also I was continually receiving complaints about dogs running there and chasing the deer out of the country. On several different occasions I sent Game Protectors in there and they found where deer had been killed and eaten up. They found tracks of what they supposed to be dogs; but were never successful in catching sight of any of them.

A few years ago, an old hunter and trapper who lives on a farm which borders the forest in a locality which is known as the 'Caughlin School section' in the Town of Belmont, claimed he saw seven wolves cross his farm, traveling in a southernly direction in single file, and going towards the woods. He claimed there was a very large animal at the head. This man has hunted and trapped wolves in Canada and he impressed me as being reliable when I talked with him.

Robert Kimpton, another old guide and hunter who resides on the Salmon River about four or five miles south of Malone, attempted to raise sheep. He owns quite a lot of land at the head of Trout River . . . and he pastured his sheep on this land. However, he had so many sheep killed that he was obliged to give up the venture. Of course, we all laid it to dogs; but Kimpton was satisfied that there was something more in that section than dogs.

Wildest and slyest creatures

Ray Burmaster went on to tell how two animals were caught alive and another one was shot. But disagreement resulted as to the true identity of the predators. His letter continues:

The male looked to me exactly wolf color, and the female was redder than any red fox I had ever seen.

I then detailed some of the Game Protectors to go into a section where we know these animals were to try and snare them. I spent some time with them myself, and I do not hesitate to say that these animals are the wildest and shyest things I have ever seen or heard of. We would find where they were disturbing beaver houses. We would find fresh signs and set a few snares in that vicinity and they would never return there again. We would hunt for several days all thru that country until we found fresh signs of them in some other locality. We would make a few sets, and that would be the last we would see of them in that section. We took a sheep up in the woods and killed it, and in due time foxes, skunk, and other animals came and ate on the carcass, but never one of these animals came near it. Foxes would follow our snowshoe trail but we never saw where any of these animals came nearer than 20 or 30 feet from the trail. If they came down off the mountain, when they got near the snowshoe trail, they turned and went back, and that would be the last we would see of them in that immediate vicinity.

The Game Protectors caught a glimpse of two they happened to surprise upon a ledge on the side of the mountain, where they were feeding on a deer. The signs there showed this pair had been feeding for a considerable length of time, but after the Protectors frightened them, they did not return there again that winter.

In February, 1934, the Protectors were successful in capturing one of these animals in a snare. . . . This was examined by the Biological Survey of Washington, and after some length of time they told me that the easiest way to settle the controversy was to call them dogs. Doctor Anthony examined it and was not satisfied to agree with their decision.

That spring Robert Kimpton shot another animal that was one of three he came on to trying to get a beaver out of one of his traps. I sent that animal on to Washington and they reported that it was a dog.

Later on that spring several of these animals were killed owing to the Supervisors of Franklin

County giving a bounty of fifteen dollars each. Several men went in and trapped them. John Garland, a very good trapper, caught several puppies and Captain Broadfield kept three of them alive. . . . One died and he still has the other two. . . . No one can get near them but him. I am enclosing a snapshot of Captain Broadfield with one of these animals. He has finally been successful in breeding them and now has five puppies which are about three weeks old. In talking with him the other day, I am quite satisfied he has changed his mind somewhat as to the identity of these animals and that he has come to the conclusion that we should not overlook their importance as predators

It would seem to me that if these animals are wild dogs that we would find different color phases among them. No one ever has found one yet any other color except wolf-gray or red or roufus. . . .

Very truly yours,
(Signed) Ray L. Burmaster,
District Game Protector,
Saranac Lake Division.

We will pass over the discouraging days of the next six weeks spent in getting hounds to follow the cold trails of unaccustomed quarry.

Elusive shadows of the thicket

Hounds are very interesting and intelligent sporting dogs but none the less aggravating at times. Besides this part has been told at some length in two hunting magazines.* To summarize many winter days followed, some rewarded with chases and some without, during which the gray shadows of the thicket earned a record of crafty elusiveness.

Then, when winter was passing, there came a wet and belated fall of snow on the evening of March 8th. The story of the next day's experience is best given by a letter I wrote the next night before tumbling into bed. If you, Reader, have followed my report so far with some of the interest of the huntsman you may consider it directed to yourself instead of W. H. Foster of Boston to whom it was addressed.

. . . It is now March 9th and tonight my every stitch is draped round the big fireplace. Wet slush is the coldest thing I know of and it has been falling on my back off the Luther pines about all day. The snow we had been waiting for started last night but by morning it was more rain than snow.

I woke at the first light and was mighty pleased, as always, to see the new snow. . . . I put Ruffian and Shotgun Joe and Tug in the truck. Old Fritz clambered into the top deck and refused to budge so I left him there.

It was a dark, lowery morning and raining plenty over across the Lake. . . . Some slush still hung to the pines so that everything was adrip. But we found a wolf track and put Ruffian on where it left the roadway.

In twenty minutes Ruff was back and ready to get in the truck. It appeared *he* was *not* a wolf dog. This was a great disappointment. Ruff is our standby on bad going. But I took Joe on leash and cut a circle around the deep gully across which the track led off. It was tough going. Quite a lot of ice on the snow and it was rotten enough to break under my shoes and with Joe's chain in one hand and my gun in the other there was no chance to save myself. Besides, the pines were planted only six feet apart and, of course, their 15-year-old branches are now interlaced.

After falling headlong several times, getting the gun barrel full of snow and plenty up my sleeves and down my neck I decided to cut across the gully. That was a mistake. In the gloom I lost bearings and first I knew I was back into the highway and hadn't enclosed the wolf trail at all. I put Joe into the truck and went up to where my companion Verne was on watch. Verne suggested my taking a little path he knew of which left the highway a mile north and this I did. But when I opened the truck door Ruff jumped out and knocked me over and Tug and Joe took advantage with the result that I had only Joe on leash and Ruff and Tug gave me the laugh as they ran off in the opposite direction from where I wanted them.

Wolf scent

But, after I'd gone a couple miles over the wood path, they thought better of the escapade, and following on, overtook me out in the densest part where Tug squealed as he got a little wolf scent. Joe took the trail too and I unsnapped his leash. Ruff didn't want any wolves. And after I'd followed along another mile or two he left me in disgust and headed back toward the car.

Trailing was poor enough but we made progress. I soon lost my bearings and when the going freshened up had no idea which way we were heading. It had continued to rain. . . . My snowshoes weighed ten pounds apiece and the lacings were a mere bag. . . .

It was two hours before I found my way out of the tangle and I was a mess by that time. Even my leather hat was soaked through. My joints were stiff.

The chase had led right back at Verne. Ruff was there and had joined in, and they made the thickets ring. Chub Halloran had arrived and he and Verne had seen the wolf *five* times while he was being chivvied around the country by the three hounds. Sometimes the big gray fellow was only a few rods ahead. At others a short turn would gain him a hundred yards' lead. . . .

Shortly after I got back to the road, thoroughly wet and miserable, the chase made a bad loss. Up to that time it had been just one furious, continuous drive. The rain was just coming in straight lines and the loss looked pretty bad, though the

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**National Sportsman*, July, 1936.
Outdoor Life, August, 1936.

hounds were still hard at work on both sides the road.

I went to the truck and found a dry piece of newspaper to wipe my glasses as I had been too blind for an hour to shoot if the chance had come. I got a dry pair of gloves, caught Joe and Tug and gave them a biscuit apiece. Then Ruff came but he went on back up north searching. After resting a minute or so the heaviest rain seemed over. So, though it was late, I took the young hounds out again.

Fritz was fresh but he is pretty old and crippled. Tug was used up. He is small anyhow and had been leading through the slush breaking path. It got later and later and the only excuse we had for sticking at it was that it would soon be dark anyhow and that somewhere in that forest there was a tired wolf. We wanted him.

The Mystery Animal is run down

Suddenly Fritz let out a single squeal away up north on the sand knoll. Joe went to him, Ruff followed and they began trailing again. Another half hour and we were again lined up while the chase faded into the southwest and away from us. It had been still for fifteen minutes when I heard a few more hoots far to the west and north. It seemed about over for the day but, through force of habit, we stuck to our appointed watches. And then a gun cracked up the road.

I'd been waiting for *that* all day. Then two more shots. Then another and five minutes another. . . . On the chance that the shooting had been done at a wolf other than the one the hounds were after I drove up the road with Tug and found Verne peering into the thickets. The hounds were still over north of us. A wolf had come out to the edge of the thicket and though Verne was waiting with cocked gun, he turned on his own trail and was almost out of sight before Verne could shoot. The charge of chilled two's cut hair and bled the wolf badly.

Verne shot twice after that but the brush was very dense. Chub was down in the gully on the trail. . . . The hounds came through while Verne and I stood there, and just before they got to Chub on the blood trail we heard his rifle crack again. This time he connected. But it was still some time before he could drag the carcass up the bank and through the dense pines. Daylight was gone when he got out into the highway again. We had to call to give him his bearings.

The hounds did not shake the carcass as they would have a fox. We set the camera up in the effort to get a picture. I gave it a minute exposure but the photos are probably not much good. . . .

I could not see any resemblance to the dog intermixture supposed to be characteristic of these animals, but expect to ship the carcass down to H. E. Anthony of the American Museum, New York City, for a close examination after Verne has claimed his bounty money.

You must excuse my enthusiasm. The hound music is always very stimulating and I now realize that I had hardly expected we could really drive one of these critters ahead of the hounds long enough to kill him. We all got a big kick out of the race and its successful outcome. . . .

I think there are at least four more of these brutes down in the Luther Trees Plantation. My own opinion is that they are wolves or coyotes and that there is no interbreeding. More than that I do not believe that these things run with the cur dogs, either wild or tame dogs. Of course, there are plenty of roaming dogs and with the actual presence of wolves or coyotes and the increased killing of sheep as a result of their presence we are bound to hear some weird stories.

The bounty, too, which hearsay has it, is $5.00 for "wild dogs" and $15.00 for "wolves," will not tend to diminish the sensational stories.

This big he "wolf" hasn't *any* dog characteristics that I can see, a chubby tail, a particularly good set of teeth, a good dense coat of underfur and most of all his peculiar odor, totally unlike any dog odor. Much more like a fox but not *quite* as musky.

I hope to get some more of the younger hounds started on them. Our older ones are too well broken to enjoy transgressing. Ruff is a wonderful fox dog, but he would not take the cold trail this morning.

Another gray predator

Following the chase and kill of March 9th came other chases. On April 8th a very large animal was cold trailed and routed and viewed by myself three times as Old Fritz and Min and Ruffian noisily chivvied him about and through the dense thickets in the Luther Plantation. The next morning our enthusiasm got us out before dawn with eight hounds. After a chase which lasted perhaps eleven hours, sunset found us with another gray predator—an old female this time. The tactics employed were largely "doubling," that is, a turning back on the trail and a wide leap aside.

This summer there are still at large several of the animals in or about the Luther Plantation. If our reading of last winter's snow pages are correct there are one large and old, one small and younger male and one young female left to harry the farmer's sheep and poultry and to take a larger toll of the fawns, bunnies and perhaps of the grouse of the wilderness.

Apparently the distribution is wide.

I have no patience with the wild dog or dog-wolf theories which have obtained credence in some quarters. There is an animal that I saw occasionally in the Wyoming Country while hunting elk during the falls of 1924-25-26. We noticed their plentiful dog-like tracks in the snow and among the dense fir thickets of Andersen Creek, of the Grey Bull and of the upper Wind River. One day, in such surroundings, I caught an instant's clear, close view of a large, darkly grizzled shape. A few days later, far in the valley below, a silhouette paused at the edge of the thicket and my long, but fortunate, rifle shot laid low a light gray animal, free from any rufous tints, which I should have called a timber wolf. But Brian Sullivan (of Ned Frost's outfit, Cody, Wyoming) identified it as a timber coyote. A bit farther east and northward they call them "brush wolves."

True enough there are plenty of wild dogs in New York State and there may be crosses of them but there are also, to my personal satisfaction at least, a plenty of Simon pure "brush wolves" or "timber coyotes," not as vocal or as small as their Mexican brethren, not as fiercely dangerous as the lobo or true timber wolf.

The verdict

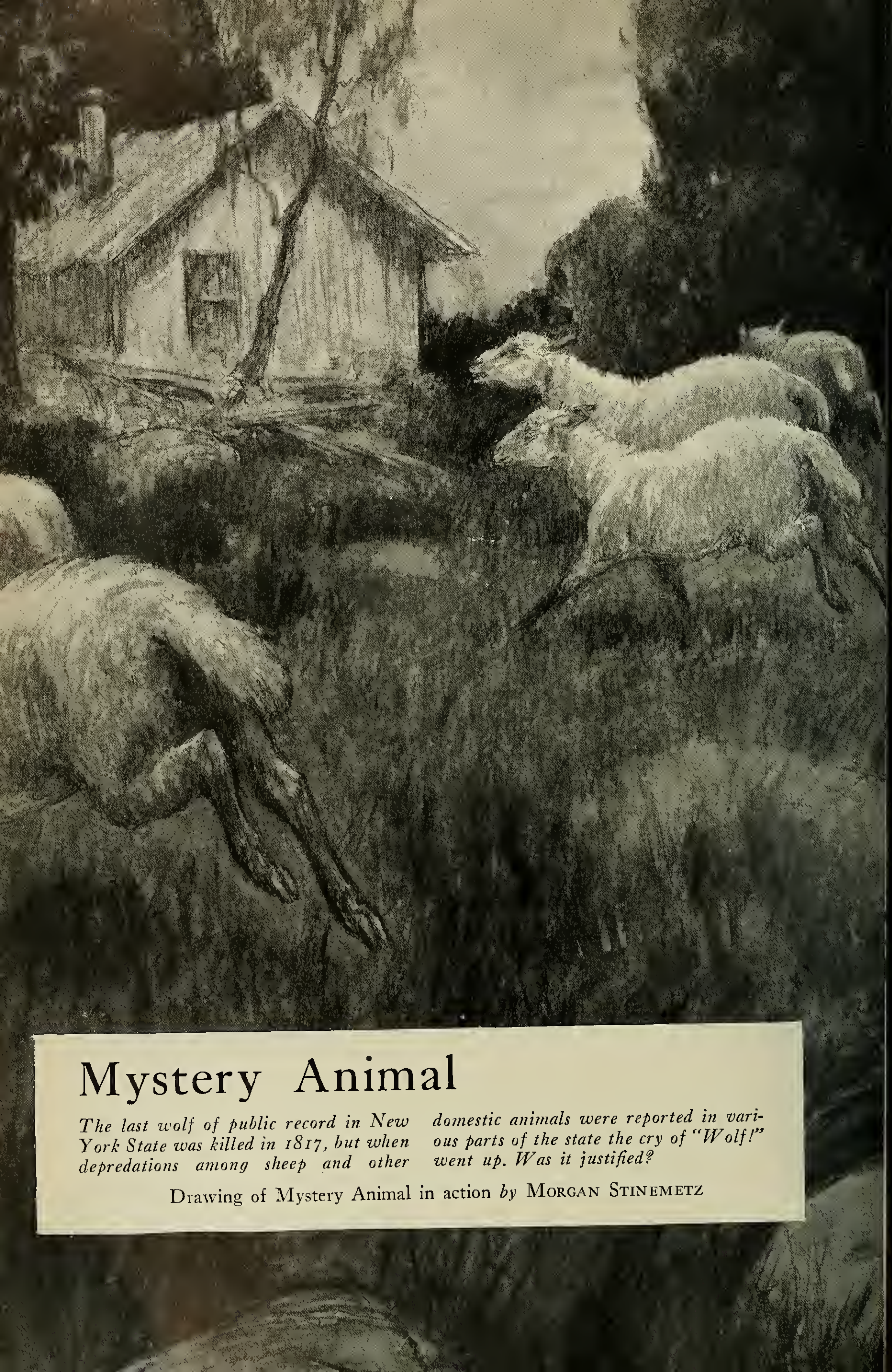
But you will want to know what Dr. H. E. Anthony thought of the two complete carcasses and the extra skull I sent him. Here is his latest letter but hope *not* the last (he has promised to come up to my hermit's cabin and join myself and hounds in next winter's observation of the development of the coyote situation):

> AMERICAN MUSEUM OF NATURAL HISTORY,
> March 23, 1936.
>
> Dear Mr. Streever:
>
> I received your letter of March 20th this morning and wish to thank you for donating the skin to the Museum. I had completed my examination of the skin and it was about to be returned to you, but the complete specimen constitutes a valuable and interesting record, and I am very glad to have the privilege of retaining it.
>
> A careful examination of the skin and skull of this animal compared with coyote, wolf and dog confirms the early impression I had that your animal is a coyote. The skull is practically indistinguishable from the skulls of coyotes taken in the Western States, and although the skin, as I mentioned in my earlier letter, is not as brightly marked as most skins of coyotes, the final conclusion must be that your animal was either brought into New York by human agency or is a descendant of such an imported coyote.
>
> Coyotes are sometimes called prairie wolves, and to the lay public there are not very many striking characters of distinction which stand in the way of considering the coyote as simply a diminutive wolf. However, there are rather fundamental differences between wolves and coyotes and the two lines of descent parted so long ago that today they are not likely to interbreed, if indeed they are genetically capable of doing so.
>
> Boiled down, this means that we do not have wolves in New York State if by wolves one means true wolves or timber wolves. The prairie wolves or coyotes which have been brought into the State by man himself are running at liberty here and thus by a stretch of the imagination one might speak of wolf-packs in New York, although this would not be strictly true. The timber wolf, the old-time wolf of the early settlers, had a head twice as massive as the heads of these coyotes, and the body of the animal would weigh several times as much.
>
> The skull of the animal which you cut off of the hanging carcass appears to belong to the same type of animal as the one your dogs ran down and I have considered it to be a coyote. I am glad to learn by your last letter that the skin of this animal was gray in color.
>
> Have you or any of your friends heard these animals howl?
>
> Assuring you of my appreciation of your cooperation, I remain,
>
> Very sincerely yours,
> (Signed) H. E. ANTHONY,
> Curator.

Undesirable aliens

And how did they get here? Specific instances of coyote and of wolf pups bought in the west by tourists, of gasoline station menageries, and of domesticated coyotes or even wolves are not hard to find nor are such confined to any one county in the State. As in the case of most undesirable aliens among us, smuggling and subterfuge has doubtless been practiced.

The problem is no longer when or how they got here but what or even whether we can do anything about it.

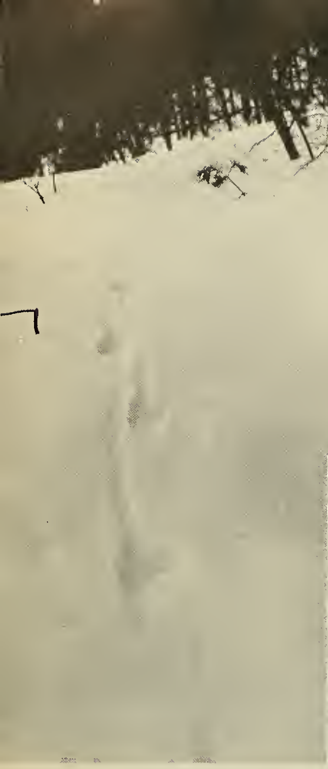


Mystery Animal

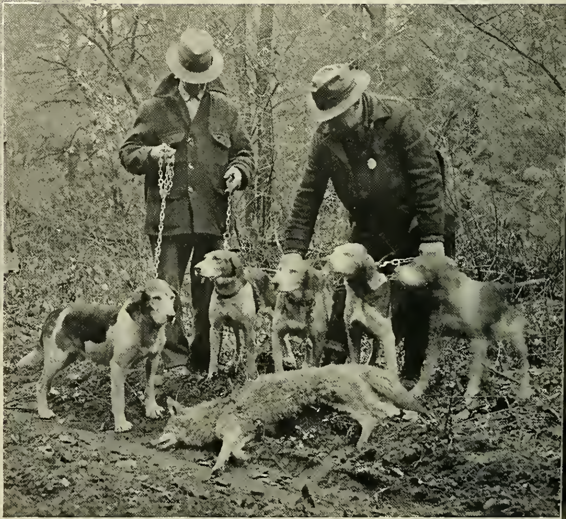
The last wolf of public record in New York State was killed in 1817, but when depredations among sheep and other domestic animals were reported in various parts of the state the cry of "Wolf!" went up. Was it justified?

Drawing of Mystery Animal in action *by* MORGAN STINEMETZ

MORGAN STINEMETZ

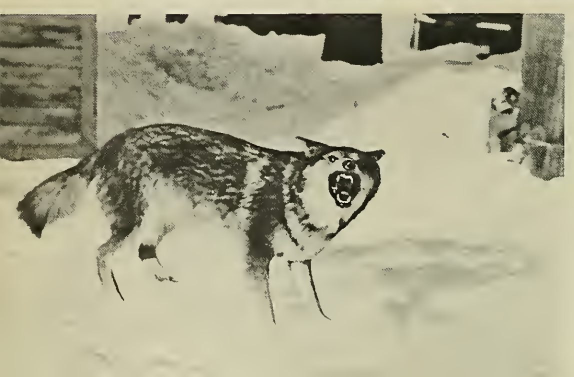


Strange tracks which strengthened the belief that there were wolves at large in New York State: prints as large as a dog's but more elongated, which threaded the densest thickets



Fred Streever Photos

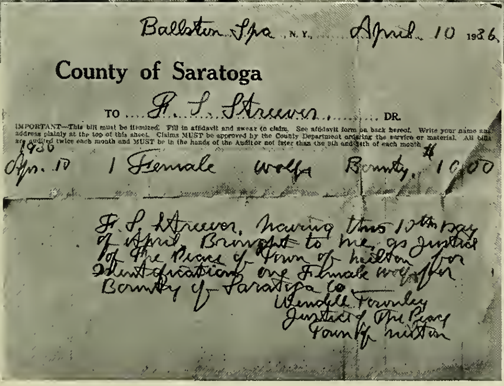
(Right) The Mystery Animal brought to earth: Fred Streever (right) and his hunting partner George Cull, with the hounds which ran the culprit down



(Left) One of the gray predators, which local hunters considered a wolf: an animal trapped by Claude L. Eddy and mounted by E. P. Hotaling

Fred Streever from E. P. Hotaling

Shotgun Joe, who liked to chase "wolves." The hounds did not shake the carcass as they would have a fox



Ballston Spa, N.Y., April 10 1936

County of Saratoga

TO F. S. Streever DR.

IMPORTANT—This bill must be itemized. Fill in affidavit and swear to claim. See affidavit form on back hereof. Write your name and address plainly at the top of this sheet. Claims MUST be approved by the County Department ordering the service or material. All bills are audited twice each month and MUST be in the hands of the Auditor not later than the 9th and 24th of each month

1936

Apr. 10 1 Female wolf Bounty $10.00

F. S. Streever, having this 10th day
of April, Brought to me, as Justice
of The Peace of Town of Milton for
identification one Female wolf for
Bounty of Saratoga Co.
Wendell Fromley
Justice of The Peace
Town of Milton

Courtesy
New York
Conservation
Department

An animal which the Kimpton Brothers brought back alive. Men with experience in trapping wolves and coyotes in the West and Canada all pronounced this animal a young timber wolf

(Left) The animal which Fred Streever brought in to clear up the mystery was a wolf in the eyes of the law; but the Museum's verdict is that these alien animals are coyotes or "prairie wolves"

The Glamour of the Giant's Causeway

A visit to one of the most curious rock formations in the world, whose scientific explanation is less generally known but no less simple than its legendary origin

By HARRIET GEITHMANN

IT IS hard to explain why certain far corners of our precious planet capture our imagination even in childhood. The Giant's Causeway on the northeastern coast of the Emerald Isle captured mine when I was scarcely bigger than a grasshopper. Doubtless the word "giant" was the first alluring feature.

Finally when I reached Glasgow, Scotland, that same childhood whimsy took me by the hand and down the River Clyde we sailed for Londonderry and the Giant's Causeway. On that outstanding occasion it seems to me that every Scottish and Irish old-timer whom we met was exactly 70 years old and had served the public for exactly 30 years. As we glided past Kilpatrick 70-year-old Captain MacCullum who had sailed between Scotland and Ireland for 30 years, flashed us a whimsical smile with this remark:

"This is the very spot where St. Patrick, the canny Scot, was born and stepped across the Clyde after which he continued on to Ireland and chased out all the snakes and became a saint."

Off for the land of "giants"

The following morning as we churned across the River Foyle under the eyes of the Ballynagari Lighthouse and entered the harbor of Londonderry, that ancient walled-in city of Ulster, famous for its linen shirts and collars, we listened to a native daughter, Maggie O'Connell, crooning softly at the rail: "O Ireland, I'm sufferin' for you," and later, "If you are Irish come into the parlor, there's a welcome there for you."

In all directions our eyes rested on enchanting woodland glades starred with chestnut and hawthorne trees in full bloom and showers of scarlet rhododendrons. On leaving Londonderry, a rocky road flanked by snowy hawthorne hedges and ash trees shaking hands overhead, led us not to Dublin but to Portrush, the very gateway to the Causeway country, a country of fairies and giants forever in the offing. All along the way we enjoyed glimpses of country life in Ulster, clean, spotless farmhouses with whitewashed walls and thatched roofs, shelter for man and beastie. To our left glistened the blue surfaces of the Atlantic with the white surf pounding at the base of the limestone cliffs. To our right were green fields of oats starred with scarlet poppies and pastures where cows, crows and goats were content. Fragrant with the romance of the sea was each and every one of the seacoast villages through which we sped on our way. There were Ballykelly and Limavady, Bellalarna and Umbro, Castlerock and Colraine, each an Irish gem of color and simplicity. Yellow laburnums and purple lilacs, primroses, bluebells and poppies made Eglinton a poem of color. Boys and their dogs drove their cows and goats along the narrow winding streets while girls, handy with brooms, waited in the doorways ready for all emergencies. Shaggy donkeys were traveling hither and yon hauling fathers and mothers and their youngsters homeward in crude carts.

An atmosphere of Irish myths

At Portrush, a 70-year old-timer, Don Martin assured us that he had driven a taxi for 30 years and if we would but deign to ride with him he would land us at the Causeway before we had left Portrush. Don was thinking in terms of American shekels hard and fast, almost too fast. We were loath to travel with such incredible speed to make our first call on the legendary bridge of the giants, therefore we cast our lot with Joe Fisher, another 70-year old-timer, who admitted that he had been a jarvey around the hills of Portrush for 30 years. Climbing into his raggety-taggety Irish jaunting-car we jogged along easily after Billy, the bay. Cracking his whip over Billy's indifferent ears, Joe introduced us to the Skeery Isles, the haven of wild ducks and rabbits, the gleaming limestone cliffs and a promontory called the Giant's Head. Without half trying we saw the giant's huge freckled nose sniffing the salty tang of the sea, his daring goatee, his noble forehead and his green cap of moss with a button on top. The Lady's Wishing Arch reminded us that we were in the atmosphere of Irish myths. High upon a velvet bluff stood the crumbling ruins of Dunluce Castle erected ages ago with an eagle eye to a quick getaway.

The Giant's this and that

Finally, Billy, the bay, dropped us on top of a knoll in the shadow of a cluster of bleak hotels. With guides galloping at our heels offering to introduce us to the Causeway by boat, we left them and the ice cream cones far behind as we jogged down a steep and rocky trail and serenely approached the geological wonder on foot. Behind a picket fence, we found 3 spits or tongues of pillared stones slanting out into the sea, the Little Causeway, the Middle or Honeycomb and the Grand Causeway, all of them in the County Antrim on the northeastern coast of the Shamrock Isle. The very moment we dropped our sixpence and went through the turnstile another 70-year old-timer, Jimmie, pounced down upon us and like babes among the stones, we gathered that if we refused Jimmie's services, the result of 30 years of experience in guiding folk over those columns, we would be lost indeed. Therefore with Jimmie limping on ahead we trekked all over the Causeway and breathed deeply of an atmosphere of giants.

Every time we turned around we heard of the giant's this and the giant's that. Jimmie introduced us to the Giant's Horseshoe, the Giant's Honeycomb, the Giant's Cannon, the Chimney Pots, and the Keystone of the Causeway, which is the most perfect octagonal pillar; the Giant's Loom, 30 feet high; the Giant's Gateway and the Bishop's Mitre, five-sided and even all around, the most perfect pillar in the entire Causeway. The Lady's Fan, a perfect combination of five pentagons surrounded by a heptagon, all embroidered with moss, was a gem. Then we found the Giant's Organ Pipes and best of all the Giant's Wishing Chair, a regular Morris chair of stone with arms and back towards the sea. Here at Jimmie's firm command we rested in the quiet air of the giants and solemnly registered three wishes all of which will come true eventually if not sooner IF we do not tell them to anyone on earth.

Thus were we personally introduced to the most distinctive members of the great Causeway family of 40,000 polygonal stones or columns, most of which we found standing perpendicularly with but a few of them lying horizontally. Most of them were arranged in sections varying from a few inches to several feet in height, all of which are fitted together like a great mosaic, convex ends and concave ends, 15 to 20 inches in diameter. Many-sided were they, triangular, pentagonal, hexagonal, heptagonal, octagonal and the largest of all was a nine-sided column. There were but two of these large columns and both of them were embroidered with tawny lichens. Jimmie pointed out that the wide sides invariably face one another and the narrow sides do likewise. We even found a diamond-shaped pillar. With the exception of the black pillars which indicated the high-water mark, the stones were silver-gray in tone, embroidered here and there with tawny lichens and tiny pink flowers. The Causeway reflects the changing moods of the Irish sky from dawn to dusk.

How it was created

Forgetting for the moment myths and metaphors, one pauses to ask how this spectacular formation was created. Geologically the Giant's Causeway is one of the most notable examples of prismatic basaltic columns on the face of this planet. It extends like a natural pier some 300 yards along the coast of County Antrim in northern Ireland and out some 500 feet into the North Channel, and then reappears at Fingal's Cave on the Island of Staffa on the West Coast of Scotland.

Other fine examples of this same kind of formation are those scenic cliffs called the Palisades on the Hudson, the Obsidian Cliff in Yellowstone National Park, those along the Connecticut River, in the traps on the shores of Lake Superior and those walls along the majestic Columbia and the Deschutes River in Oregon.

As to the volcanic origin of this extraordinary columnar structure, authorities generally agree that during the Tertiary Period a great outpouring of basalt took place in this locality. As the molten lava was going through the process of cooling and contracting, it apparently broke up into regular sections of polygons in much the same manner as mud flats or even quantities of starch will dry and crack up into polygonal shapes when left to the mercy of the sun. It has been pointed out that the composition of the lava must have been unusually uniform. At the Giant's Causeway these polygons are strikingly regular and range from a few inches to several feet in diameter. While most of them are hexagonal, some of the columns are four, five and seven sided due to the fact that the centers of contraction were not always equally spaced. Both at the Giant's Causeway and Fingal's Cave the prismatic jointing of these basaltic columns has been developed to a high degree.

Like cordwood on end

Another principle seemingly true of this particular type of prismatic structure is that it invariably develops at right angles to the plane of cooling and resembles so much cordwood all stacked on end. This horizontal plane of cooling was not a surface layer of air but a thin formation of overlying rock which has since been removed by the agents of erosion.

The entire area of both the Counties of Antrim and Londonderry are known as the red zone, owing to the basaltic red iron ores which overlie them. These ores are the direct result of the underlying sheets of basalt, some 300 to 500 feet thick, the same igneous material out of which the Giant's Causeway was formed.

"Beyond yon point," smiled Jimmie serenely, "lies the Spanish Bay where the giants destroyed the Spanish Armada all because the soldiers dared to fire on these same limestone cliffs thinking they were fortresses. And on that rocky promontory to your left you can see the Giant's own grandmother forever struggling up hill with a sack of chicken feed on her poor old back. However long you watch, she never seems to make the summit."

In another romantic niche among the stones we found the Giant's wishing-well and Jimmie's own white-haired buxom frau biding her time on the brink, ready for thirsty and superstitious mortals with pitchers and cups. There we wished again as we slaked our thirst from the bubbling spring water and paid another sixpence as we wished. When all of these wishes come true, but that's another story.

At the crown of the bluff, waited Billy, the bay, and Joe Fisher a-top his raggety-taggety Irish jaunting-car.

"Did Billy have a good rest?" we inquired as we climbed in.

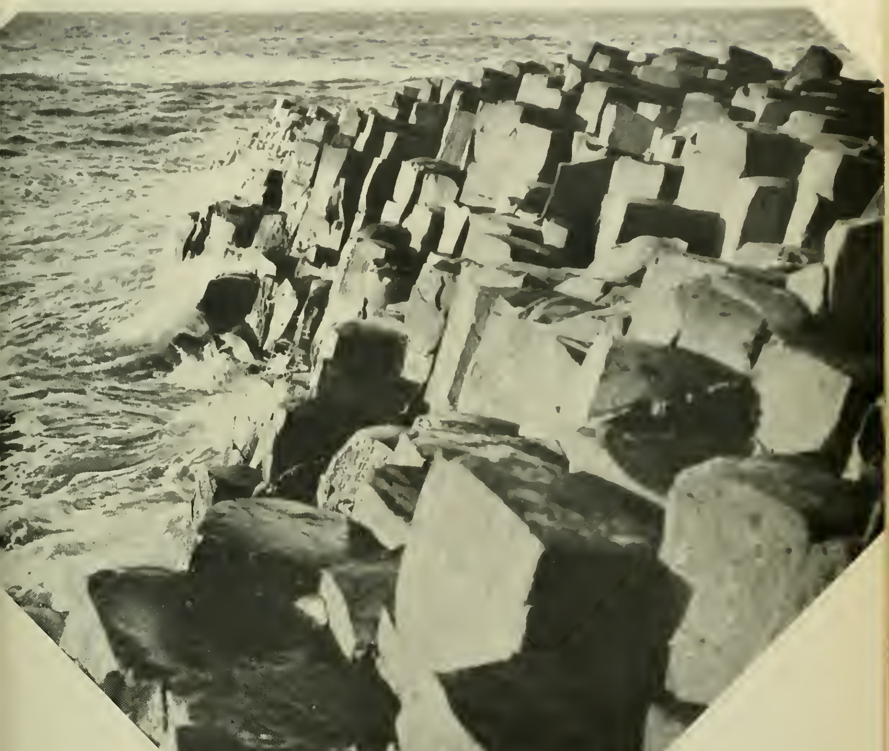
"Aye," laughed Joe, "he had a nap and a feed of corn."

More legend

Bouncing back to Portrush we learned more about the mythical Causeway. "Long before the memory of man," mused Joe, as he flicked his whip over Billy's ears, "the Giant's Causeway was created. 'Tis certain no engineer built it. Around the hills of Portrush we believe it was built by an Irish giant who had a quarrel to settle with a Scotch giant who lived across St. Patrick's Channel at Fingal's Cave. He even challenged the Scottish giant to come over and fight it out and the brawny Scot said he would be glad to accommodate his enemy IF he would build a bridge, which he did. The same formation is to be seen out at Fingal's Cave on the shores of the Staffa Islands. No one seems to know exactly who won the famous bout but we Irish have our own opinion and then there's the Causeway, this end of the Giant's bridge."

With this long speech Joe looked out over the Channel at Fingal's Cave and cracked his whip disdainfully.

Joe's legend sounded almost plausible to our American ears. We found it easy to listen to these 70-year old-timers with their 30-year-old experience along the romantic shores of the Shamrock Isle, especially in the atmosphere of the fairies and giants of the Causeway country.

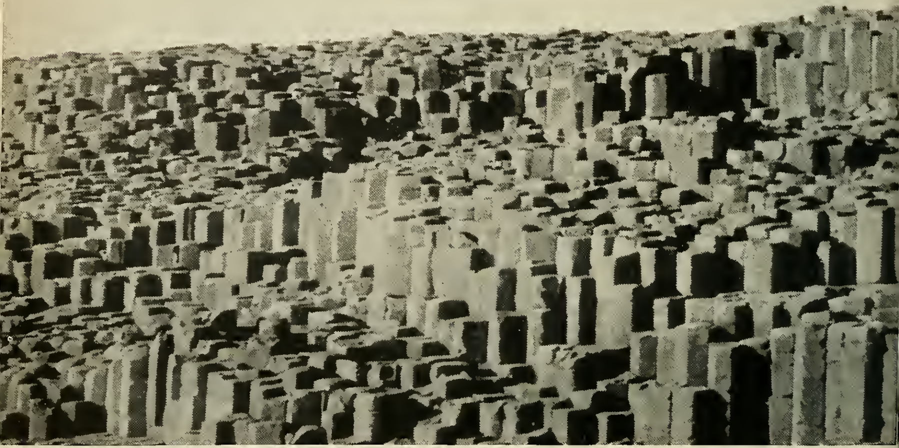


De Cou from Ewing Galloway

The Giant's Causeway

A mosaic of forty thousand polygonal columns of stone comprise the Giant's Causeway, on the northeast coast of Ireland. Except where the tide reaches them, the columns are silver-gray in color, embroidered here and there with tawny lichens and tiny pink flowers.

Legend has it that the Causeway was built by an Irish Giant who challenged a Scottish Giant living across the channel at Fingal's Cave, daring him to come over and settle a quarrel. The Scot is supposed to have replied that he would accommodate his enemy if he would build a bridge across—which he did. If you don't believe the story you can find the other end of the bridge at Fingal's Cave. No record revealed the quarrel's outcome

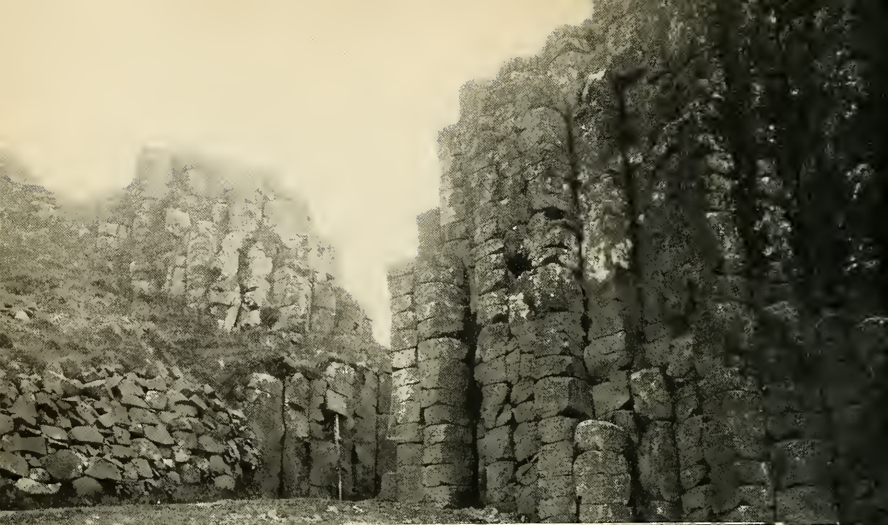


The Giant's Causeway extends like a natural pier for some 300 yards along the coast and out about 500 feet into the North Channel. It is one of the most remarkable examples of prismatic basalt columns in the world. It was formed when a great outpouring of molten rock cooled and cracked into polygonal sections, much as mud does when it dries

The columns are strikingly regular and range from a few inches in diameter to several feet

Ewing Galloway

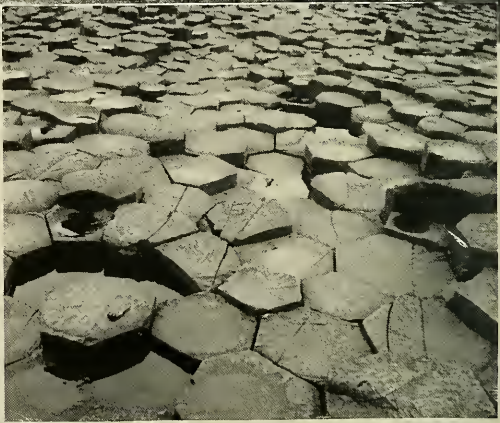
De Cou from Ewing Galloway



E. M. Newman from Publishers Photo Service

It is no wonder that the heavy blocks of stone which in places appear to have been put in place by human hands are attributed in legend to a giant

(Right) A honey comb in stone: a level space on the Giant's Causeway. The majority of the columns are six-sided, but as many as nine sides are sometimes to be seen



Ewing Galloway

An unusual view showing the size of the sections that make up this volcanic wonder. The sides are not equal, but it is to be noted that the figure is symmetrical, opposite edges being similar (Photo: Mrs. Branson de Cou)

Science in the Field and in the Laboratory

Total Eclipse Photographed—Trophies from Indo-China —Swordfishing—Fall Lectures.

Astronomer in Siberia: A Total Eclipse, Huge Craters

For a brief period this summer, the sun ceased to shine on a part of what once was the Russian Empire, and astronomers who had presaged the event eagerly looked forward to the discovery of additional information regarding that body.

Dr. Clyde Fisher, head of the Hayden Planetarium, had two objectives in mind when he sailed last May for the Soviet Union. His expedition called for motion pictures of a total eclipse, and an investigation into the enormous Siberian craters that had been gouged out of marshy ground in the meteoric deluge of June 30, 1908.

A recent report from Doctor Fisher states that in conjunction with Harvard's expedition under Dr. Donald Menzel, he was able to record photographically this solar phenomenon whose path of totality extended from the Mediterranean Sea to Greece and thence clear across Siberia and northern Japan to the Pacific Ocean. Camera conditions were perfect but he has not yet seen the developed film.

Doctor Fisher's efforts to attain his second objective were crowned with no such success. Only a few hundred miles from Ak-bouliak, in Kazahkstan, where the eclipse pictures were taken, lies the scene of one of the most socially calamitous, but scientifically important meteor showers in history.

Almost exactly 28 years before the occurrence of the total eclipse, 200 shellhole-like craters appeared as if by magic in about 2 miles of swampy forest. They were left in the wake of a meteoric torrent that felled and unbranched trees, shattered peasant huts, slew whole herds of reindeer, and was recorded on a seismograph at Irkutsk 900 km. away. Only one expedition, under the Russian professor, Kulik, has visited these giant craters, some of which stretch 50 yards in diameter. So it was but natural that Doctor Fisher was anxious to extend his expedition with a view to contributing further information. He was disappointed to learn, however, that an excursion to the craters was impracticable at that time.

In a late communication to Mr. Wayne Faunce, Vice-director of the American Museum, Doctor Fisher was able to give more heartening news. "The whole thing," he says, "may be affected—I am not quite sure—by the fact that the Soviet Government has planned, and financed, they say, an expedition to these craters next year. The permanent secretary of the Academy, who is one of the finest two or three Russians I have met, told me that if I wished to accompany this expedition, I would be welcomed.

"After being disappointed about the Siberian craters, I concluded to try to visit those on the Island of Saaremas (Osesel), Estonia. Estonia is straight west of Leningrad, and therefore is directly on my way back to Stockholm. I shall try to gather material about these craters for an article in NATURAL HISTORY. I feel sure they have never been visited by an American—probably by very few scientists."

D. R. B.

Fleischman-Clark Indo-China Expedition

Deep in the jungles of Indo-China Dr. James L. Clark lolled beside his expedition camp fire and listened to squadrons of elephants trumpeting in the spring night, as they trampled nearby grassy patches.

Accompanied by Major Fleischman, he had taken leave from his post as head of the department of Arts and Preparations last February to become co-leader of an expedition predicated to the collecting of museum specimens ranging from mammals like the banting, a big wild ox that resembles a handsome Jersey bull, to frogs and lizards.

Establishing headquarters at Saigon in March, the expedition headed north for a 300-mile trip into the jungle, ably guided by M. Defosse and his son Louis.

Automobiles transported the expedition to a little place called Dong-Me, where a camp and field laboratory were set up. "Two weeks spent here resulted in a fine collection of the vividly colored local birds, snakes, bats, and interesting lizards of several varieties," reports Doctor Clark.

Often plodding 12 to 15 miles a day under a scorching sun, excursions set out on foot from Dong-Me in pursuit of the banting. Several specimens were secured, including a fine bull and cow. Of these, the complete skeleton of the bull, and both skins were preserved. Fresh tiger trails were seen almost daily, and elephants, plying in all directions, left their broad, smooth trails. Integral specimens of the wild pig were also taken here.

The expedition then moved southward about 200 miles to the Lagna River where, on the broad grassy plains of this great game section, specimens of the wild water-buffalo were hunted and secured, as well as the Saladange, the hog-deer, the mouse-deer and numerous reptiles and fishes.

By this time bullock carts had replaced the automobiles, and carried food and duffle over winding bumpy trails further into the jungle. A base camp was organized on the river bank among big trees and elephant grass, where tigers more than once left their spoor a scant hundred yards away.

"Three weeks were spent in this locality building up collections until torrential rains, the beginning of the rainy season, drove us homeward to save the valuable collections already secured," says Doctor Clark. "Sizes of specimens varied from the giant water-buffalo weighing three thousand pounds to the tiny mouse-deer which weighed but four pounds. This specimen, a full-grown female, standing hardly eight inches at the shoulders with tiny hooves so small that they would hardly cover the rubber of a lead pencil, contained a fully developed foetus which by itself weighed almost half a pound. This interesting and valuable biological specimen with its entire envelope was saved as a complete formaline specimen. A large male and female elephant skull helped swell the collection, but no tiger, as the time necessary to secure this spectacular trophy would not have been justified in scientific value.

"In all, although the expedition spent only five weeks in the field, the results are most satisfactory. The preserved specimens were left in Saigon where they were packed for shipment directly to the American Museum."

Birds of the Congo and "Penguin Island"

Dr. James P. Chapin of the Department of Birds sailed for Belgium July 18th to continue work on the second volume of his "Birds of the Belgian Congo" at the Musee du Congo Belge in Tervueren.

* * *

Readers who remember Mr. Willy Ley's fascinating article *"The Great Auk"* (NATURAL HISTORY, November, 1935), telling how this flightless "north-penguin" was slaughtered into extinction, will be interested to know that on July 20, Thomas Gilliard of the Department of Birds, with Samuel K. George, succeeded in reaching Funk Island, the former metropolis of the Great Auk, thirty-four miles off Newfoundland. The absence of safe anchorage made it essential for them to embark four hours after landing. Nevertheless, they succeeded in collecting enough Great Auk bones to construct at least one complete skeleton, and in taking a census of the other birds nesting on the island.

Reconnoitering for Bisons and Antelope

On July 7th a preliminary expedition under Robert McConnell accompanied by Robert Rockewell of the Museum Department of Arts and Preparation set forth to survey the antelope herds roaming the Wyoming plains about 60 miles south of Cody. Antelopes move in scattered groups in summer and their pelage is poor. Therefore no attempts were made to take specimens. With the approach of winter, however, antelopes segregate in larger groups, are more attractively furred and offer a wider selection to the collector.

After a few days in the antelope country, Mr. McConnell inspected the semi-wild buffalo herds maintained on the National Bison Range near Missoula, Montana, by the United States Biological Survey. These buffalo are permitted to retain their natural habits, and are protected from hunters. Mr. McConnell is making necessary negotiations with the Government for permission to obtain specimens of this herd for a proposed Museum group.

Apart from its initial objective of performing the requisite groundwork for a collecting expedition this fall, Mr. McConnell's survey corps was aole to bring back with them several interesting species of birds and small mammals.

Plans are on foot to assemble a new Antelope-Bison group in the Museum's North American Hall, from specimens taken during the expedition contemplated this autumn.

Animal Life in the Rockies

Temperatures averaged 14° below zero last December, when Mr. George G. Goodwin studied wild life on the western slopes of the Rocky Mountains.

Colorado again lured the Assistant Curator of Mammals on June 19th, when he returned to the same section to continue his researches under summer conditions.

This project was made possible through the generosity of Mr. Harry Snyder of Chicago, who, with Mr. Goodwin, has made expeditions into northern and western Canada which have been recounted in NATURAL HISTORY (September, 1935, and May, 1936).

Swordfishing in Nova Scotia

Through the generosity of Mr. Michael Lerner, an expedition to the swordfishing grounds off Cape Breton, Nova Scotia, left New York on July 25th, under the auspices of the American Museum of Natural History.

The personnel of the expedition consisted of: Michael Lerner, John Treadwell Nichols, Curator of Recent Fishes; Francesca LaMonte, Associate Curator of Ichthyology; Harry C. Raven, Associate Curator of Comparative Anatomy; Miles Conrad, Assisant Curator of Comparative Anatomy; Ludwig Ferraglio of the Department of Preparation and Exhibition; and Anthony Keasbey of the Department of Ichthyology.

The Nova Scotian Government placed a large boat at the disposal of the expedition for collecting up and down the coast and adjacent islands, and also supplied a motion picture operator. During the last part of their stay, the expedition moved down to Wedgeport, Nova Scotia, for the big tuna run off Soldier's Rip, where it collected data for exhibit material in the Museum. A laboratory has been established at Louisburg for studies of the anatomy, food habits, and other data on the fishes of the region, particularly the swordfish.

Planetarium News

During the month of September the lecture in the Hayden Planetarium will be on the subject TIME AND NAVIGATION, including discussion of such points as time-keeping of the ancients, time and space, the elementary fundamentals of navigation, and the sky as a time-keeper, with discussion of the various kinds of time. During September there is to be in the Planetarium an exhibit of ancient and fine timepieces. The watch used by Lincoln Ellsworth at the South Pole will also remain on exhibition on the second floor of the building.

During September, on clear Tuesday evenings, a telescope will be available outside the Planetarium after the eight and the nine o'clock lectures for Planetarium visitors. The moon, the planets, and various other interesting sky objects will be viewed at these times.

Radio talks under the auspices of the Amateur Astronomers Association will continue over Station WHN, on Friday nights from 7:30 to 7:45.

The regular meetings of the Amateur Astronomers Association and the Junior Astronomy Club will commence again for the year 1936-37 early in October.

During September Jupiter is a bright object in the evening sky, setting about four hours after the sun. Saturn comes into the sky about sunset by the middle of the month and is in view all night. At this time it is at its maximum brightness for the whole year, magnitude 0.8.

Education Notes

During the last three weeks of July there was an exhibition in Education Hall of 52 water-colors of Panama's fruits and flowers by Mrs. Marie Louise Evans of Balboa Heights, Canal Zone.

An exhibition of the work done last summer in activity programs by children who attended the summer play schools and day camps of WPA 1563, under the supervision of the Board of Education, will be on view from Sept. 21st to Oct. 15th.

During July and August the Department of Education instructors accommodated about 5,000 children from the Play Schools of New York City. These youngsters were given an hour's instruction in the halls and an hour of motion pictures.

On July 13th, 20th and August 3rd three groups of young students from Germany totaling 125, were conducted through the Museum by special guides. Every year under the auspices of the West Side Y. M. C. A. groups of this type have been coming to the United States.

Lectures

The American Museum of Natural History, through its Department of Education, will again offer a number of courses in cooperation with the colleges and universities of the city.

FREE COURSES FOR TEACHERS: *Methods of Teaching Geography* in an Activity Program by Mrs. Grace Fisher Ramsey; *The Museum in Elementary Social Studies* by Mrs. Ramsey; *Nature Study for City Teachers* by Miss Farida A. Wiley.

A new offering to teachers of New York City public schools is a course *Craft Techniques,* including Miniature Habitat Group Making, Finger Painting, and Nature and Geography Crafts. The brevity of the course does not permit the granting of alertness or college credit for the work.

Pay courses in Astronomy, by Dr. Clyde Fisher, will be offered by Hunter College and New York University. College or university credit will be allowed for all these courses, as well as alertness credit by the Board of Education.

The regular lecture courses for classes of public school children will be continued, including auditorium lectures for elementary school pupils, lectures in biologic science for high school biology students, exhibition hall talks, sight conservation talks, and specially arranged lectures and demonstrations in the Hayden Planetarium.

Free Saturday afternoon programs of educational motion pictures will be given for the general public at two P. M., beginning September 19th. At four P. M. on four consecutive Saturdays, starting October 24th, Mr. Herbert P. Whitlock will give a free talk on *The Appreiation of Gems,* including jade and amber.

Oceanic Birds of South America

Twelve hundred copies of Dr. Robert Cushman Murphey's two-volume work of this title were issued, after which the type was destroyed. At the date of issue of this number of NATURAL HISTORY less than one-third of the edition remains in stock. In all parts of the world the work has been received most favorably and has been awarded praise by bibliophiles as an extraordinarily fine example of printing, illustration, and format, no less than by scientific men for the excellence of its plan and text.

NOTE

An error occurred in regard to the volume and issue number on the binding of the June NATURAL HISTORY. The designation should be volume XXXVIII, No. 1, and subscribers who intend to bind the magazines are notified that the June issue should be placed at the beginning of the second volume of 1936 rather than at the end of the first volume as the erroneous figure might suggest.

Acknowledgment

Owing to an ambiguity in the official records credit was not correctly given in the January (1936) issue of NATURAL HISTORY for the procuring of the young bull elephant in the Akeley group. Opportunity is taken at this time to state that this animal was collected by Mrs. Delia J. Akeley.

RECENTLY ELECTED MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Honorary Life Member

Mr. James Zetek.

Life Member

Mrs. William F. Sanford.

Sustaining Members

Mrs. William H. Good

Messrs. W. K. Kellogg, Noel Robinson, F. S. Streever.

Annual Members

Mesdames Harold Amory, Grenville Clark, Jessie Benedict Faye, Meredith Hare, Herbert Du Puy, James J. Lee, O. L. Loring, Richard H. Mandel, Howard E. Perry, William Clement Scott, I. De Ver Warner, Sylvan E. Weil, Frieda B. Winner, Richard W. Woolworth.

Princess Xenia of Russia.

Misses Ethelwyn Doolittle, Elisabeth Harris, Anne S. Richardson, Anna L. Slater.

Reverend John F. Ross.

Doctors Afranio do Amaral, John V. N. Dorr, Frances Holden, Robert L. Levy, Madge C. L. McGuinness.

Honorable James A. Fitz-gerald.

Messrs. Joseph Adams, Malcolm P. Aldrich, Charles L. Allen, Elliot S. Benedict, J. L. Berston, Corwin Black, Elmer G. Diefenbach, Joseph L. Fleming, E. F. B. Fries, Alfred Henry Friedman, William J. German, Alan Hazeltine, Carl T. Keller, Robert Meyer, George Oenslager, Rushmore Patterson, Stephen Peabody, Max Rosenwald, William H. Schroder, Lester S. Thompson, William Richard Townley, R. Alan Turner, Clark Williams, Dudley F. Wolfe.

Associate Members

Mesdames R. A. Arnold, Moses Ascher, Donald S. Barrows, Charles Bovey, Miller Brennan, Anna B. Claster, John Winchester Dana, Leon A. Dodge, Septa L. Dooley, Stella J. Ernat, Charles N. Felton, Leonard Freeman, Edward G. Gardiner, E. H. Gipson, W. T. Haines, Allen K. Hamilton, May D. Hausling, E. K. Hebden, Albert E. Heller, John Eric Hill, Geo. Hillyer, N. S. Hopkins, Wm. H. Hyde, Francis Nash Iglehart, Frederick C. Johnson, George K. Kaiser, Dorthy M. Kelley, Edmund Key, Jr., Helga Larsen, Eldon Macleod, B. F. Myers, Jean L. Naylor, William C. Parnell, John W. Price, Jr., G. W. Prior, M. G. Stewart, Walter M. Taussig, J. F. Terriberry, Geo. E. Twiggar, Caroline M. VanBrunt, H. L. Walcutt, C. C. Walker, William S. Wandel, C. Raymond Weaver, Sydney Webber, A. U. Whitson, Nancy L. Wolverton, Franz F. Ziegler, C. T. Zoebisch.

Misses Ella Vollstidt Allen, Dorothy Arnett, Peggy Atlas, Mabel A. Barkley, Barbara Bassett, Sophie F. Baylor, Ida T. Bixby, Beatrice J. Brady, Lilla M. Brown, N. Margaret Campbell, Ellen J. Collins, Jean Crager, Marian Crocetti, Minna Durschnitt, Esther Gellman, Betty Hall, Mae Hatfield, Catherine D. Hauberg, Orpha M. Hayes, Ottilie Margaret Heil, Helen V. Hofmann, Beatrice I'Anson, Isobel Julien, Ida K. Langman, Emma H. Loomis, Anna Looser, Veronica MacEwen, Margaret Macfarland, Ann McDiarmid, Julia W. McIntrye, Maria M. Morrow, Dorothy Morse, Margaret L. Murphy, Mildred S. Narins, E. Virginia Orr, C. H. Ouwerkerk, Harriet T. Parsons, Inez K. Payne, Mae Belle Peck, Rachel Pitman, Margaret Rhodes, Margaret Roderwig, Helen C. Rogers, Alice G. Sanders, Elizabeth L. Sawyer, Anne Sherman, Elizabeth J. Sherrett, Jean Smith, Anna L. Sommer, Edna J. Sperry, Elizabeth H. Vanneman, Sally Welsh, E. E. Whitney, Marianne Wolff, Caroline R. Woolley, Vera Zeip.

Reverends Charles Graves, William B. Hays, A. P. Kashevaroff, Charles E. Lillis, Harold Pattison, Eliot White.

Colonel James Perrine Barney.

Lieut. Comdr. Walter M. Wynne.

Major H. W. Lockett.

Doctors Clairette P. Armstrong, Wm. H. Bickley, Walter H. Brattain, G. B. Capito, M. D. Cramer, Nathan Smith Davis 3rd, Charles Edwin Galloway, Rudolf Geigy-Heese, Aldis A. Johnson, Paul Klemperer, H. A. Krieger, F. W. Lee, J. M. Martin, Lyle G. McNeile, M. R. Newcomb, Hugo O. Olsen, George C. Paffenbarger, Harlan Page, B. W. Rhamy, Philip Q. Roche, Heinz Schmid, Geo. P. Sims, Alva Sowers, Clarence B. Tanner, H. M. Tolleson.

Professors George B. Barbour, A. M. Popov.

Messrs. George F. Abderholden, Sumner Abramson, H. Laurence Achilles, John G. Alioto, Charles W. Allen, Henry Butler Allen, Henry M. Allen, Sloan Allen, Oscar P. Allert, James Anderson, O. J. Anderson, Edward Appel, W. H. Austin, Malcolm B. Ayres, W. M. Bailey, A. H. Baku, Ezra James Barker, E. Munroe Bates, Herman T. Beck, Ralph L. Blaikie, Emanuel Blumstein, W. Boaz, Norris Myles Brown, Joseph Bruchac, Frank Bruen, Ben B. Cain, Barton Haxall Cameron, J. L. Camp, Donald B. Clark, A. W. Cooms, Fox B. Conner, Thomas B. Cornell, W. H. Cowles, T. E. Curran, Glenn Daun, Arnold G. Davids, Gudmundur Davidsson, George M. Demm, Robert A. DeWolf, Charlemagne Tower Drew, Allan A. Drimie, L. C. Elrod, Winston Elting, Paul Favour, Peter Foote, M. H. Forster, Ira Garfunkel, S. M. Gloyd, David Gramkow, Morris A. Greenwald, Howard Gresmer, Eugene Grimaldi, Herman E. Halland Jr., Robert J. Hamershlag, John W. Hammond, Frank Hankin, Robert M. Harris, Walter Hastings, Geo. L. Havemeyer, Ken L. Henderson, B. N. Hendricks, F. Whitehill Hinkel, Henry Charles Hoar, Abe Hoffman, J. H. Howard, Ralph E. Hubbard, C. R. Hudson, Alfred Huse, James Jackson, A. K. Jenkins, E. Kenneth Jenkins, Parks Johnson, Peter Jordanoff, C. Fred Joy Jr., Wm. J. Kihn, Nandlal Kilachand, Samuel R. King, Robert Marvin Krassner, Alexander Kreithen, Ralph G. Krieger, Thomas K. Lazure, Derek Thayer Lees-Smith, H. Grant Leonard, Roger G. Leonard, Alan M. Limburg, George West Liskow, William R. Lodge, Duncan Longcope, Alberto Martin Lynch, Jacob L. Markel, George T. Marsh, Ralph C. McConnell, John M. S. McDonald, James R. R. McEwen, John A. McGregor, Floyd J. Miller, W. A. Mitchell, J. E. Moore, George S. Munson, John M. Murray, Walter P. Muther, Karl Erik Nasmark, Herbert L. Nichols Jr., T. H. O'Brien, E. Ospina-Racines, Watson Parker, LeRoy W. Parsons, Southwick Phelps, Edwin T. Phillips, Fred J. Pierce, Walter G. Pomering, Kennett F. Potter, Fred J. Raffelson, Homer F. Rensch, Lee W. Reynolds, Royal P. Richardson, F. H. Rivers, W. B. Roberts, P. H Robertson, Edmund B. Rogers, Morrison Rogers, George Bowyer Rossbach, F. A. Schaff, F. S. Selby, David Rives Sigourney, Elihu A. Silver, E. J. Simonek, Berry Cushing Smith, Earl E. Smith, Lee Smits, Albert H. Sonn, E. B. Sprague, Guy H. Stanton, Theo. E. Stebbins, Henry H. Stickney, Otto Stoll, John H. Storer, Hans Ris Studphil, Irving Stutz, Richard C. Sullivan, John A. Sutro, G. Arthur Swan, C. G. Teitsch, Ben H. Thompson, H. R. Turner, George H. P. Van Alst, Bernard Van Ingen Jr., Walker Van Riper, J. Varley, Howard H. Warner Jr., Wm. H. Welsh, Harry Sylvester Wender, Fred G. Whaler, George W. Wheelwright, Lawrence Whitcomb, Charles L. Williams, Murphy M. Williams, Wm. W. Wood, J. H. Woods Jr., W. D. Craig Wright, Christian C. Zillman Jr.

Frank Richard Oastler

HUNDREDS of men and women in this city and throughout America are mourning the passing of Dr. Frank Richard Oastler. A grandson of Sir Daniel MacNee, one time President of the Royal Academy of Edinboro and a great grandson of Sir Richard Oastler, he achieved distinction as a physician and surgeon and for many years was chief surgeon of the Lenox Hill Hospital and professor of surgery in the College of Physicians and Surgeons of Columbia University. Men and women in all works of life will long remember his professional skill and they will treasure equally his great spiritual qualities which led him to a sympathetic understanding of the serious problems of their personal lives. When he had given to his patients from the best of his medical knowledge and experience he still had much in reserve for them. Not unlike the Great Healer, he sustained those who depended upon him by the very essence of his own spiritual life. No one ever left his counsels without a stronger faith in themselves, a better hope for the future and a firmer belief in the goodness of life.

Unless one knew of the personal life of Doctor Oastler he might well wonder at the man's incredible vigor, his boundless optimism and his astonishing youth. When still a young man and realizing the need for a balance to offset the rigors of his professional life, he sought and found refreshment for his mind and body and sanctuary for his soul in the wildest and most beautiful mountains of the West. Each summer for more than a quarter of a century he spent three or four months traveling by pack train along the great rivers, over the flower-filled alp-lands and across the great glaciers and high passes of the American and Canadian Rockies. In the course of time he and his wilderness-loving wife came to know almost every peaceful valley, deep canyon and rugged peak along the Great Divide between the Colorado and the Yukon. All these natural beauties of landscape and the wild creatures of the rocks and the forests he photographed and he became a master of the photographic art. The rare trumpeter swan at nesting time along the shallows of some mountain lake; the big horn sheep in his high fortress among the cliffs; the beaver busy in the construction of his river home; the woodland caribou, the moose, the elk, ranging amid dark forests of spruce and balsam—all these and a host of lesser creatures became his friends. Thousands of feet of film and colored slides of wild life and virgin country were his dearest treasures—and even more, the memory of the wilderness which they recalled. Using his film and slides in his lectures for charity, he raised large sums for the alleviation of human suffering.

Ardently opposed to the hunting and killing of animals for sport, he fathered the conservation of the wilds and was primarily responsible for the creation of several of our National Parks. This great nature lover "lifted up his eyes unto the hills" and drank deep of their streams of inspiration.

—MARY L. JOBE AKELEY

Your New Books *by D. R. Barton*

Men of Science—Island Lore—Jungle Nights—The Sky—A Lonesome Drum

TRAIL BLAZERS OF SCIENCE
- - - - - by Martin Gumpert

Funk & Wagnalls, $2.50

"In the service of nascent truth . . .
Men die, are executed, tortured . . .
But the Idea is immortal."

"TRAIL Blazers of Science" is a magnificent tribute to the tenacity of the human organism in the face of every conceivable physical torture and spiritual mortification. It first appeared in Germany under the title of "Das Leben Fur Die Idee." Mr. Edwin Schuman has given a faithful and gifted translation whose sensational title may be defended on the grounds that the book's message will reach a larger audience.

With the following words the author epitomizes the great, sad, *Leitmotif* that recurs with Wagnerian solemnity throughout the pages of his book:

"The world allows itself to be converted to its true forward steps only reluctantly. Animals take fright suddenly and become accustomed slowly. *Mischief has another, quicker dynamic than benefaction.* The good deed lacks the moment of terror with which the evil deed paralyzes the understanding and enthralls the heart. Out of this difference is born the world's unrighteousness."

It is a sickening tragedy of human existence, that the men whose brains propel the very lifestream of our civilization, must, in the name of precedent, be bodily and spiritually crucified by blundering contemporaries. The author's task is to tell of the lives of certain heroes of world and scientific history in such a way that they become the protagonists of progress in "the bitter warfare between myth and knowledge." Laity will be unfamiliar with many of their names—but the task is admirably fulfilled. Doctor Gumpert is articulate to the point of artistry, as well as being a sound scholar and an able scientist.

The heroes are grouped according to the centuries in which they lived. Starting with the 16th, there are Cardan, Vesalius and Servetus, all more or less brutally victimized by religious intolerance.

In the 17th Copernicus and Kepler investigate the heavens, and Swammerdam, the world of insects. The dawn of man's evolution is discovered by Wolff and LaMark in the 18th. Robert Mayer is confined in an asylum for the insane because he published the law of the conservation of energy; Jackson and Morton fight bitterly for the credit of discovering ether anesthesia, and Von Pettenkofer lays the foundations of modern hygiene, in the 19th.

Despite Dr. Harvey Cushing's incontestable brilliance, and the great benefits his work has undoubtedly bestowed on mankind, your reviewer deplores the author's selection of him as the hero of the 20th century. This great brain surgeon does not seem to be the rightful heir to the crown of pain that passed inexorably from one to the other of the preceding heroes. Doctor Cushing saw little of the bitter opposition, and downright oppression of his illustrious forebears. True, he was scoffed at—but he was not expatriated, strait-jacketed, or burned at the stake. Encouraging though this may seem, it lends a note of false security to the facility of progress in our own times.

For, all too often, dark forewarnings of a growing reaction against intellectual achievement are filtering into current news reports. Organizations at Doctor Gumpert's doorstep are carrying out programs of religious persecution which have discriminated against some of the world's most enlightened minds.

No. The human race has not yet learned to detect its benefactors. Mischief has still "another, quicker dynamic"—and all is not well.

You feel somehow, that the 20th century held out a challenge to Doctor Gumpert, before which he faltered. It is not denied that the difficulties of fact-gathering would be enormous and the risks, tremendous. Then, too, he would probably suffer the very indignities and griefs he so righteously laments in the lives of his heroes. There would be a curious justice in that—but one, Doctor Gumpert does not wish to contend or explore. Because of this, his life will be, perhaps, simpler and happier—his book, truly brilliant—not truly great.

THROUGH THE TELESCOPE

- - - - - - - by Edward A. Fath

McGraw-Hill Book Co., Inc., $2.75

NO doubt there are many admirable books for the beginner in Astronomy, and for those whose interest is merely casual. But this is certainly one of them.

Since Edward A. Fath, who is professor of astronomy in Carleton College, is the author also of an excellent textbook of astronomy—a standard, somewhat technical work—his credentials are in order.

Through the Telescope, however, is anything but technical. It is eminently for the layman. Professor Fath points out that he wished to include no more than could be read in one evening by a reasonably rapid reader. In this he has succeeded, for his style allows of swift and pleasant reading. It is friendly and easy, though never careless; light, almost breezy. One finds a minimum of "science" and a maximum of what is curious, and essential, and human in astronomy.

The book is amply illustrated with well chosen drawings and photographs.

The reader is taken, in imagination, on a journey to two great observatories, the Lick and Mt. Wilson. Through the giant telescopes there he makes his acquaintance, evening after evening, with one celestial character after another—a novel way of making first contact with the sky, and a good one.

The writer points out later, in speaking of a minor planet, "It would be impossible to have a baseball game on the asteroid, for every long hit would drive the ball off the asteroid altogether. The ball would never return but would swing around in space as a separate minute planet in an orbit around the sun."

Significantly, Professor Fath sub-titles his book, "A Story of Astronomy." It does not pretend to be *the* complete story of astronomy. Many such stories must be written before the tale would be fully told. But as *a* story it is heartily recommended.

—ARTHUR DRAPER

GREEN LAURELS

- - - - - - - by Donald Culcross Peattie

Simon and Schuster, $3.75

"The living world as you came to it with the ardor of first love."

THAT lush style of Mr. Peattie's, so fragrant, so plump with adjectives, will whip city-dulled sensibilities to a tingling new awareness of Nature, will open the eyes of the young novice, will strike tremulous chords of emotional recognition in the sensitive soul.

Skeletally, "Green Laurels" is a mere collection of biographies. But the body of the book, the central theme, is "man's mind as it is concerned with Nature."

Mr. Peattie begins with the Medieval herbalists—and their first tiny emergence from the dusty gloom of ever-reiterated Aristotle. The progress of Malpighi, Swammerdam and Leeuwenhoeck is deftly traced. Then on to the decadent court intrigues of the pouting Pompadour, and the part she played in the lamentable feud between Buffon and Reaumur.

He tells how the green world unfolded under the nordic eyes of Linneaeus; how LaMarck lived, learned, and died, and of Cuvier's opposition to him.

Swiftly, then, the book turns to that vast laboratory of the Naturalist—the New World. How Michaux and Bartram, the wilderness plantsmen, fared therein, and how Wilson and Audubon studied and sketched under harsh difficulties.

Comes the bizarre career of Rafinesque, and that of the hopelessly impractical Thomas Say.

Back in Europe, he toys amusedly with the "rose-water teleology" of Goethe and the Romanticists. Thence to Darwin, and Wallace and the familiar tale of the world's reception of the evolutionary theory.

Jean Henri Fabre is his last figure. Lovingly the author extols the courage and fortitude displayed by the naive, little Frenchman in his devotion to the cause, amid the most depressing domestic heartbreak.

That its author discloses nothing the practising Naturalist could add to his store of information is not to be deplored. It is enough that the book should stimulate an interest in those spiritual rewards to be won by intelligent contemplation of plant, bird, and animal life in all its infinite variety. Science must have its popular apostles. And Mr. Peattie might perhaps be styled as ace "contact man" for botany and ornithology.

HARPOONER - - - - by Robert Ferguson

Univ. of Pennsylvania Press, $2.50

"Large oyster shells as big as wheelbarrows"

SIMPLICITY with the ring of truth fills the pages of this whaler's diary making of it a vital document on a now vanished way of life.

Mr. Leslie Dalrymple Stair's editing is to be commended for its admirable restraint in preserving intact the impressions and activities of Robert Ferguson as they were actually recorded during his voyage on the ship *Kathleen* from 1880 to 1884.

A python's gaping jaws, the horror of an Arab slave market, brawls on shore and at sea—all these and much more he describes in addition to the authentic technique of his precarious profession.

Almost automatically, one calls to mind Richard Henry Dana's "Two Years Before the Mast." But Ferguson is no Harvard man (his formal education ended at the age of 9) and his prose is as free of the polished rhetoric of that classic as it is of the mysticism of Melville.

It is curious indeed, that this simple, God-fearing seaman should achieve fine literary effects by a style whose verbal economy so markedly resembles the studied medium of certain noted writers of our own day.

"AN ODYSSEY OF THE ISLANDS" - - - - - - - by Carl N. Taylor

Scribner's, $3.00

"No sounds . . . save the splash of fish or crocodiles, the sucking of stealthily moving feet in the mud, and an occasional cry of some raucous, night-flying bird."

MR. TAYLOR gave up a job in the university of the Phillipines at Manila with the idea of devoting a month to arduous travel through the islands lying beyond the scope of the white man's civilization. His odyssey lasted more than a year.

At once a story of high adventure and an unflattering commentary on the arbitrary attempts to superimpose one culture upon another, it is narrated with surpassing skill and a certain masculine charm.

Readers who prefer their explorations untainted by sensationalism will not be disappointed in the author's treatment. He was determined to write an utterly honest report of human life as it exists in the little-visited sections of the Phillipine archipelago, and, undaunted by danger, hardships or fever, has achieved a well-deserved success.

Starting from the southernmost end of the islands, his odyssey took him, by devious out-of-the-way paths, to the extremities of Luzon in the northeast. In its course, he joined in the almost Neanderthal hunts of the pygmy Negritoes, was "cured" of dysentery by the weird contortions of a Sea-Gypsy Medicine Man, sought gold in the domains of chronic head-hunters, and most impressive of all, saw minor civilizations, drifting, before his very eyes, toward inevitable extinction.

His camera was always with him, and the abundant original photographs are worthy companions of the text.

Mr. Taylor has few panegyrics for the civilizing processes contrived either by the Spanish or the United States governments. He says, at one point, "I was trying to think of some blessing that the Government had bestowed upon these people who had gotten along and prospered for forty centuries by their own efforts." He ridicules the absurdity of teaching children of the indomitable Morro outlaws to reverence "a pale little boy with a hatchet . . . who was not ingenious enough to tell a necessary lie, a trait of character foreign to the oriental nature, which not even their Christian teacher can understand."

The author is not a confirmed opponent of every well-intentioned, albeit clumsy, effort of the Phillipine administration to "improve" the natives. His is simply a plea for a truly enlightened program. It is a curious justice that permitted the author, in a sense the patron of subject peoples, to die last February, by the hand of his houseboy, while at work on an investigation into the rites of the Penitentes in New Mexico.

HOW TO USE YOUR MINIATURE CAMERA - - - - - - - - by Ivan Dmitri

The Studio Publications, N. Y.

TO the person contemplating the purchase of a Leica miniature camera, or to the recent owner of the same instrument this book makes a valuable starting point. The opening pages are devoted to a minute discussion of the mechanical operation of the Leica. The instructions go so far into the taking of pictures as to show the effect of each of the various lenses obtainable.

Perhaps the most valuable part of the book lies in the second part that contains the illustrations. It is here that the beginner starts to appreciate the field of the miniature camera in catching "life on the wing." The unposed "candid" photographs of animals and babies as well as unusual speed shots of performers on the stage display the wide variety of subject matter open to the miniature camera enthusiast. Exposure data and information of interest about unusual conditions under which the picture was made are given for each picture so as to help improve the judgment of the miniature camera user when confronted with a difficult subject. —CHARLES H. COLES

DESOLATE MARCHES by L. M. Nesbitt

Harcourt Brace, $2.50

". . . read the tale in my ragged clothing and bleeding hands and my unquenchable thirst."

PESTILENTIAL flies that lay sight-destroying eggs in the corner of the human eye, myriad ticks that bore and feed in the skin, vampires that suck the blood of sleeping victims, these and many other spawn of the Venezuelan jungle make "Desolate Marches" a well-named book.

An untimely Alpine death has cut short the promising career of its author, L. M. Nesbitt, engineer, traveler, adventurer—and above all a writer so gifted as to merit comparison with W. H. Hudson. No more, will he plod, stricken with fever and dysentery, behind the swinging machetes of his trail-breakers. He has surveyed his last wilderness, written his last book, and a noble mind has passed from among us.

"Desolate Marches" is a worthy legacy.

Frankly autobiographical, it is the story of his surveying expedition in the region of the Orinoco basin. On this framework is woven an unforgettable display of the frightful squalor and degeneracy of the natives, together with a few vagrant whites, who, forsaken by their own civilization, sink likewise to the brute level, crushed by the invincible jungle.

The prevailing grimness is, however, not unrelieved. Here and there he comes upon an amusing or admirable being—and his descriptions of the natural surroundings are eminently beautiful. He makes pets of many of the animals and birds, and despite his sufferings and discomforts, expresses, at the end, a genuine regret to leave the verdant wasteland that held so great a fascination for him.

CHILE: LAND AND SOCIETY

- - - by George McCutchen McBride

American Geographical Society, $4.00

". . . a New World Country with the social organization of old Spain; a 20th century people still preserving a feudal society . . ."

MR. McBRIDE'S impressively documented yet readable volume is an impartial and scholarly analysis of the vast social problems facing the Chile of today.

Chile has its grandees—*hacendados* they are called, most of whom trace their ancestry back to the original holders of the *encomiendas* (land grants from the crown during the colonization period). So deeply entrenched is their hereditary position of ownership, that a Chilean authority has declared: "In Chile there exists a greater monopolization of the agricultural land than in any other country of the world."

The soldier forefathers of the *hacendados* wrested the country from the Indians, settled on large royal grants, and remorselessly forced the conquered people into vassalage. So began this long dynasty of overlords. Indeed one may describe Chile's history as the history of its *hacienda.*

Each *hacienda* is a remarkably self-sufficient unit. It has its own blacksmith, wet nurse, seamstress or veterinary, and its store sells tobacco and light wines to the laborers. The latter have often lived all their lives on the *hacienda,* as had their fathers before them. They are between 75-90% illiterate and until this generation it has not been attempted to make them otherwise. All opportunities for education and culture are open only to the *hacendado* and his family.

At the outset of the twentieth century this two-class system of "Master and Man" began to disintegrate. Periodic need for workers in the mines and nitrate fields, and other causes created a class of nomad laborers, who go about the country selling their labor power. A third estate of small farmers, and a few isolated, collectively owned communities arose. Lastly, due to increased exports, room for industrial labor was effected.

It thus became increasingly apparent that the *hacienda* system had outlived its usefulness.

Mr. McBride traces the stormy history of Chile's politics; shows how in every crisis, the *hacendados'* interests gave ground only grudgingly—and concludes that there is a very real danger of their losing all their lands, if they do not consent to the equitable redistribution of part of them.

The book is by no means exclusively a compendium of the economic history of Chile. Its author writes admirably of the people themselves, of his personal contacts with them and their work. He tells of the land they live in; its sprawling mountain ranges, teeming forests, and varied climate. He supports his text with a large number of interesting photographs and maps, that enable the reader to gain a vivid picture of a turbulent and colorful nation.

HOW ANIMALS DEVELOP

- - - - - - - - - by C. H. Waddington

Norton, $2.00

HERETOFORE, the embryologist has concerned himself with the problem of observing and recording with descriptive accuracy each phase of embryonic growth and differentiation. Mr. Waddington centers his discussion in the as yet unsolved problem of what makes animal tissues develop and integrate as they do.

The most striking discovery brought to the reader's attention is that of the apparent existence of one or more "organization centres" within the tissues, determining the character of the specialized organs which become differentiated in the individual. Mr. Waddington cites as an example that when frog's skin is grafted experimentally into the mouth of a newt, it becomes induced to form a mouth, apparently due to the presence of an "organizer" determining the nature of the organ demanded in that area; but the skin, having come from a frog, is only competent to form a frog's mouth, which it therefore forms in place of the totally different mouth of the newt.

Such discoveries as this suggest the complexity of interaction in living tissues and the difficulty of discovering completely the causes underlying embryonic development. Mr. Waddington is optimistic in his view of experimental embryology, and his book *How Animals Develop* looks forward to future clarification of the field.

WITH PLANE, BOAT, AND CAMERA IN GREENLAND

- - by Dr. Ernst Sorge

Appleton Century, $5.00

"Loneliness makes a man reflective; hardship sharpens his insight; suffering steels his will to conquer; these things educate him to full manhood."

THIS book is a description of the German expedition to Greenland in 1932, which had the double purpose of: (1) filming the fiords as background for two motion pictures, "S O S Iceberg" and a comedy; and (2) the scientific examination of the fiords and glaciers.

Sinclair Lewis has somewhere lampooned a travel book with the description "trickles of mint-flavored text around large raw hunks of illustration." Apart from some thoroughly interesting observations on, and experiments with, Greenland's glacial deposits, Doctor Sorge's prose and photography produce the reverse effect. The many cooling photographic inserts (which might be called mint-flavored) are most remarkable for their depiction of glacial phenomena, particularly the "calving" of the Rink Glacier.

Doctor Sorge made three trips to this glacier. The first time he lost his collapsible boat and was stranded. But, with spartan calm and courage, he faced eight days of privation and hand to hand grappling with the frozen wilderness aided only, mind you, by a gasoline stove, a thermos bottle, a waterproof sleeping bag, canned milk, pea soup, corned beef, pumpernickel, butter, blutwurst and coffee. And was finally located, fed, and rescued by an airplane. "It is odd," he remarks, "how soon a man can accommodate himself to a situation when there is nothing to be done about it, particularly when he is strong and fit."

The book contains very readable accounts of Eskimo life, splendid descriptions of the landscape, and is rich in highly informative material on the glaciers.

Indeed the descriptions and documentation of the book are important contributions. One only wishes that the Herr Doktor had not seen fit to justify almost every activity of the expedition, from the importation of zoo-reared polar bears for photographic purposes to the needless icy plunges of actress Riefenstahl, on the basis of his chest-thumping Prussian ideology.

LISTEN FOR A LONESOME DRUM

- - - - - by Carl Carmer

Farrar & Rinehart, Inc., $3.00

ANCIENT Seneca ritual, performed within sight of the glowing sky above the countless electric lights of Buffalo; glimpses of spiritual life one hundred miles from Manhattan where religion is not a narcotic, but a stimulant, an aphrodisiac; Red Men without faith in seemingly benevolent government legislature; White Men renouncing the federal constitution on the grounds that it nowhere mentions God; under-graduates handling game cocks; spiritualist mediums, the descendants of Noyes' communist stirpiculture;—all these Carl Carmer has found in New York, Empire State of the union.

He says, "Here men, wondering at words spoken from the bodiless air, listening for a lonesome drum, have sent their minds beyond the realm of experience, where, like eager hawks, they have seized on shining prey and brought it triumphantly to earth. Let theologians and philosophers weigh the trophies. It is enough for some of us to know the hunters and to hear the tales of the hunting."

That, it seems to your reviewer, is the fault with this book. Mr. Carmer seems to accept it as fact that the people of whom he writes, are such as they are, through causes too tenuous and fragile for the categories of science.

He has given us an unbiased, searching account of human existence throughout upper New York State. He has set down its folkways with painstaking accuracy, mimicked the various speech idioms, learned the songs, jokes, and legends of each locality; in short, done a beautiful and vigorous job of reporting. But these up-staters are for the most part, ignorant, backward people. The residents of the Bristol hills, the Chenango people, and the sundry "cracker box" characters that abound in the book—present the picture of a culture that has fallen deplorably short of its potentialities. Frontier days and ways are remarkably alive—and this would seem, in a state that boasts the largest, most technically advanced metropolis in the world, quite as much a chiding commentary on America, as a eulogy of its multifarious modes of living.

"Listen for a Lonesome Drum" in the final analysis is an excellent and honest sociological document, artfully written by a man who reveals himself but sparingly.

HIGH TRAILS OF GLACIER NATIONAL PARK by Margaret Thompson

The Caxton Printers, Ltd., $3.00

BOUND by hand, beautifully illustrated and written, this book is a refreshing example of individual craftsmanship.

Smoothly, with the effortless appeal of a good writer who knows her subject, Miss Thompson reveals the panorama of grandeur that is Glacier National Park, touching upon the history of its development, its people, and the wild life that abounds within its borders.

She makes a singularly well documented plea for a more enlightened treatment of the American Indian. She shows how, in an astoundingly short period of time, these tribes were reduced from a virile, independent people to a burden on the public dole. Since they are citizens, why, she contends, could they not benefit by legislation at least as progressive as that enjoyed by their conquerors?

Miss Thompson's book will appeal to any one interested in nature. The sportsman, the geologist, the artist and the anthropologist—all will find moments of delight in her pages.

THE CONQUEST OF YUCATAN

- - - - - by Frans Blom

Houghton, Mifflin Co., $3.50

"THE history of the greatest civilization of ancient America is like a gigantic jigsaw puzzle of which we only have some pieces."

Frans Blom, of Tulane University, is a leading authority on the Mayas, and his book is a beautifully contrived attempt to reconstruct their culture, as well as being a memorial to the Yucatan that existed before the coming of Spain, armed with cross and sword.

GEOGRAPHY, AN INTRODUCTION TO HUMAN ECOLOGY

- - - - - by C. L. White & G. T. Renner

D. Appleton-Century, $4.00

A THOROUGHLY readable work in which the author lifts geography out of the realm of factual compilation, and applies to social geography the succession concept introduced into botanical ecology by Cowles.

DOGS, CATS AND MONKEYS

- - - - - - by Rene Bache

Dorrance & Co., $1.25

ANY animal fancier, particularly one whose interest lies chiefly in dogs, cats and monkeys, will find curious little gems of information, which together with the many delightful anecdotes and tales of animal heroism, make this volume one of the more illuminating in its field.

TREASURES IN THE EARTH

- - - - - - by Edward F. Fitzhugh, Jr.

The Caxton Printers, Ltd., $2.00

"MORE tangible, more awe-inspiring than ever, and extremely useful." Thus Mr. Fitzhugh describes the science of geology. In lucid, fast-moving, and what is important to the lay reader—nontechnical language, he shows the applications of scientific knowledge and methods to the mining of "Treasures in the Earth."

COMPARATIVE PSYCHOLOGY, VERTEBRATES

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BIRDS IN THE WILDERNESS

- - - - - - by George M. Sutton

MacMillan, $3.50

DOCTOR SUTTON, Curator of Birds at Cornell University, has given us an engaging account of his adventures with birds in the field, in a popular manner.

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1935

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2 June, 1936

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Vol. LXXI—The American Land and Fresh-Water Isopod Crustacea. By Willard G. Van Name.

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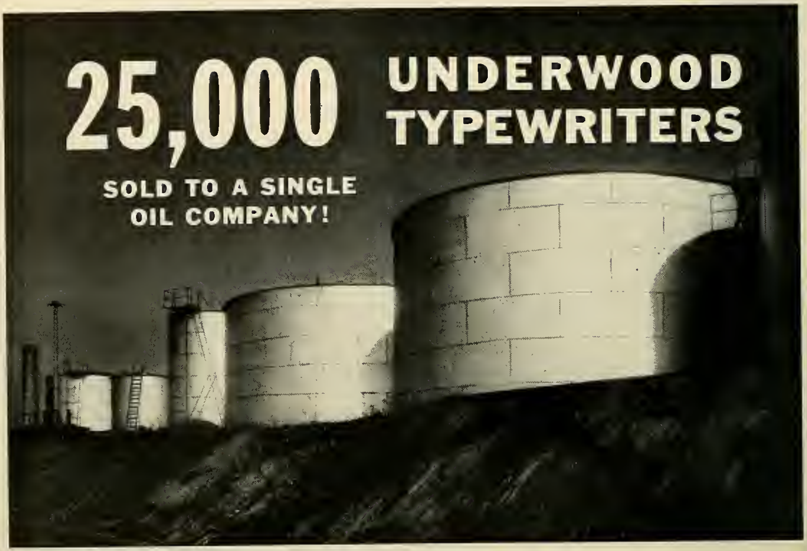

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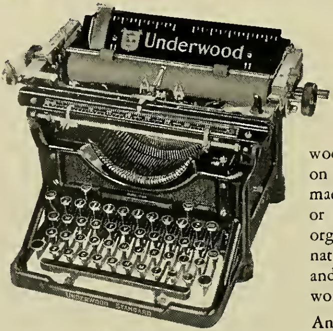

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NATURAL HISTORY
October
1936

Natural History is published monthly (except July and August) at New York, N. Y., by The American Museum of Natural History, Seventy-seventh Street and Central Park West. Subscription price $3 a year, single copies fifty cents. These rates also apply to Canada, Newfoundland, and all foreign countries. Entered as second class matter March 9, 1936 at the Post Office at New York, New York, under the Act of August 24, 1912.

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The Magazine of the American Museum of Natural History

VOLUME XXXVIII ★ ★ ★ ★ **OCTOBER 1936**

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Publication Office: American Museum of Natural History, Seventy-seventh Street and Central Park West, New York, N. Y.

Editorial: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

Subscriptions. Natural History is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

Advertising: Sherman P. Voorhees, The American Museum of Natural History.

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Behind that Door

A résumé of some of the world's strangest and most interesting occupations "behind the scenes" at the American Museum

By ROY CHAPMAN ANDREWS

Director, American Museum of Natural History

THE American Museum of Natural History is not only a vast "place" with twenty-three acres of floor space, an average of twelve thousand visitors a day and housing, besides its exhibits, a whole village of nearly a thousand people engaged in such diverse activities as tanning hides and manufacturing electric power to measuring insects under a microscope and forging metal cases. It is an immense FORCE, adding bit by bit to the sum of human knowledge, gathering its information through research and exploration and disseminating it through its publications, lectures, radio broadcasts and its Department of Education.

Largest in World

Unlike many other institutions of its kind, the American Museum of Natural History will take you behind the scenes where you may gain a new insight on the myriad problems involved in running the largest institution of its kind in the world. Any member of the Museum, or properly accredited visitor, may obtain a pass through that door marked, "Public Not Admitted."

When he steps through that door what does he find? First, that any organization of this size, though it be devoted to science, in its practical details comes under the head of Big Business. The Museum has its own power plant that supplies light, heat and ice for all of its buildings. It requires the entire time of two men just to replace electric light bulbs and clean the glassware of lighting fixtures in these buildings. The cost of these bulbs alone amounts to $5500 a year. Akeley Hall, which is still only partially completed, with many of its exhibits unlighted, requires $1100 worth of bulbs a year.

In the basement there is the Carpenter Shop, where fourteen men are employed every work day of the year making all carpentry repairs and office alterations, doors, cases, furniture and picture frames necessary for the Museum. Next to it is the Machine Shop with its fifteen permanent employees, who are kept busy doing all the iron work, forging and roofing, the repairing of locks and machinery, the making of metal exhibition cases as well as special metal work for the Curators. It was the foreman of the Machine Shop, Jacob W. Shrope, who, under the direction of Dr. Roy W. Miner, invented the waterproof camera case for undersea photography.

Sharp-shooters

Beside the Carpenter and Machine Shops are the Electrical, Plumbing, Paint and Masonry Shops. It requires the full time of six masons to keep the tiled floors and other stone and brick work of the Museum in repair. Few visitors know that in its basement the Museum maintains a shooting range where the men who guard its treasure practice marksmanship at regular intervals. In addition to the regular armed guards distributed throughout its halls, special guards protect the Morgan jewel collection twenty-four hours of the day. This hall

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(Left) One step in the long process that brings science to the public eye: a Museum Sherlock Holmes studying a fragment of a reptile long-since vanished from the earth

has an individual electric alarm system and when it is closed to the public the guard is locked in.

One of the busiest departments "behind that door" is the Print Shop. Started in 1903 with one man and a hand press, this Department has grown to such proportions that most of the Museum's publications, including Natural History Magazine, which was handled by our own printing press and bindery as late as 1934, have had to be sent to outside printers. And still the Print Shop has trebled its output since that date. Here are just a few of the items it turns out: booklets for the Department of Education, Junior Natural History Magazine, all circular work and stationery used in the Museum and all labels that accompany the specimens throughout the exhibition halls. This last alone is a formidable item. Two orders in one day called for seven hundred and sixty different labels. Besides its regular work, the Museum press has printed the first volume of the late Professor Henry Fairfield Osborn's Proboscidea Memoir.

Before taking the elevator to the upper floors perhaps you would like to visit the Shipping Room, through which pass all the express, freight and other heavy goods that enter or leave the Museum. Through its prosaic doors pours much of the glamour of travel and exploration. Among the daily average of fifty incoming shipments are motion picture film, crates of fossil bones, Museum supplies and live animals. The latter, mainly frogs, turtles, lizards and snakes—the poisonous ones come wrapped in burlap inside a crate—are destined for the experimental laboratory. Frequently when some animal dies at one of the City's zoos the Shipping Department truck calls for it and brings it to the Museum where it is used for research work. Here too, all expedition equipment is packed, or crated, and sent to the interior of Africa or the coast of Patagonia. All skins and other material sent or brought in from foreign countries comes, under bond, to the Shipping Room where it is examined by the Custom's officials.

If you take the elevator from the basement you are politely told at the fourth floor that there are no exhibits above this floor. The fifth floor is "behind that door." Here a totally different sidelight may be obtained on the vast and varied activities of the Museum. On your way to the Library you must pass the Mail Desk which handles, besides all incoming and outgoing letters, about three hundred publications and from ten to twenty packages a day. Among the latter are specimens sent to the Museum for exchange or identification by scientists or amateurs from all parts of the world. In one day's mail there may be a live toad from Colorado, a dead snake from Borneo, fish, minerals, bits of meteors or bones. Many of these are gifts to the Museum and are turned over to the proper department when they can be used. The Mail Desk occasionally receives a well-intentioned offer of a donation for which it can suggest no recipient, such as that of a woman who brought in a pet dog which she was going to have destroyed and inquired if the Museum would like to have the pelt.

The Museum Library with its one hundred and nineteen thousand volumes, while pri-

HAYDEN PLANETARIUM

Drawn by Joseph M. Guerry

marily maintained to provide reference literature for the scientific staff, is frequently used by visiting scientists, writers, artists, explorers, representatives of commercial firms and students in their search for special information, references or illustrations on some subject pertaining to natural history. Here one may meet such well-known explorers as Admiral Byrd, William Beebe, Lincoln Ellsworth and members of expeditions going to Sumatra, the Bahamas or the South Pole getting in advance the information on climatic, geologic and hygienic conditions necessary for their trip. Artists, commissioned to make cover designs or illustrations, come to the Museum Library in search of such material as "jungles in Java" or "domestic cattle grazing in Palestine." A motion picture producer consulted the Library regarding the kind of cart to be used in a Rudolph Valentino picture with a South American background. The Library also cooperated with an automobile manufacturer and a silk manufacturer in the production of two expensive catalogues advertising new color schemes based upon exotic birds, fish, minerals and gems. Industrial research laboratories, writers of travel pamphlets, compilers of encyclopaedias and newspaper and scientific editors are among those who meet behind that door.

Jigsaw puzzles in bone

On the same floor is one of the most interesting rooms in the Museum, the work shop of the Department of Paleontology. When the visitor to the Dinosaur Halls sees the skeleton of some prehistoric animal it looks as though it had risen complete from its million-year-old grave. The fact is that it may be composed of twenty thousand fragments of bone that have taken months, even years, to piece together bit by bit like a jigsaw puzzle. In the work shop these bits of bone are spread out on long tables and sorted into separate piles by experts who can tell by the texture and appearance to what part of the animal each fragment belongs. Patiently these pieces are fitted together and glued with a composition of paper pulp. In some cases the bones are found in comparatively soft substance but when they are imbedded in rock they must be removed with the aid of fine dental instruments and microscope.

Before leaving the field every effort is made to find the entire skeleton. Where this is impossible, the missing parts are reproduced in plaster. In the case of a recent remarkable discovery by Dr. Barnum Brown of the remains of a prehistoric stem animal—the first of its kind ever to be found in the United States—a half inch section of the femur was discovered to be missing. The following year another expedition was made to the same spot. Three weeks were spent in the field and eight tons of earth and débris sifted through a fly screen and washed. The result was enough small pieces of bone to cover the bottom of a cigar box, among them the missing half inch of femur. There is no school except experience in which to learn the technique employed in the Paleontology work shop. Many of the men engaged in this work have been developing and perfecting their methods through more than thirty years of practical experience in the Museum. The result of their labor is casting a new light on the history of the world.

Artistry in glass

From the reconstruction of mammoths and mastodons it is but a few steps to the Tower Room where microscopic organisms are being magnified and accurately reproduced in glass. Mr. H. O. Mueller, the Swiss glassblower who has been with the Museum for more than forty years, has perfected a technique so individual that his exquisite replicas of delicate microscopic invertebrates are not only of inestimable value to the student of natural science but in themselves are works of art. In the Tower Room too, are made the lifelike fish one sees in the exhibition halls. Plaster casts, measurements and paintings are made of living fish in their natural environment. From these, exact reproductions are made of wax and other materials and painted by expert artists.

One of the questions most frequently asked by visitors to the Museum is, "are the trees and flowers in the habitat groups real?" A visit to the Preparation Department, which occupies an entire building, will answer that question for you. Although constant development of new technique and the invention of new methods by the scientist, artists and engineers on the Museum's staff are taking place in every department, progress is perhaps most marked in the Preparation Department. From the days when animals were stuffed with sawdust, and cotton leaves were purchased from a millinery supply house, to the artistic perfection of the recently opened Akeley African Hall, with its startlingly lifelike groups, indirect lighting, invisible glass and architectural perspective, is a matter of a few years, and yet this advance, growing out of the inspiration of the late Carl Akeley, has been brought about by the Preparation Department of the American Museum of Natural History under the leadership of James L. Clark and his Associate Chief, Albert E. Butler.

Animals frozen solid

The groundwork for the mounting of animals and the reproduction of background is done by the expedition in the field. Plaster casts, measurements, motion pictures, still pictures, paintings and samples of rocks and plants as well as the bones and pelts of the animals form the basis for the work that is carried on and completed in the Museum. A large refrigerator room on the fourth floor of the Preparation building takes care of the perishable specimens until they are ready to be mounted. It is also used to freeze solid in lifelike poses whole dead animals for study by the staff sculptors. Opposite the refrigerator room is the tannery where the stiff, salted skins arriving from the field are transformed into smooth, supple pelts, as easy to work with as fabric. These are no longer "stuffed" but fitted onto a paster cast of a sculptured animal.

Whenever possible, real tree trunks, plants and grasses are used after having been dried and having their color restored with an air brush. In most cases, however, they must be reproduced in wax, glass, celluloid or other materials. So accurately and skilfully is this done that only a close comparison with the original will betray the difference. The new eliptical niches used in the Akeley Hall habitat groups presented a problem in painting background scenery which was solved by James K. Wilson, architect and artist on the Preparation staff. As an animal, tree or other object painted on a curve would appear foreshortened to anyone standing in front of the exhibit, a chart must be made before painting in the background to determine the exact proportions that will appear natural to the spectator.

On the Preparation staff are such artists and sculptors as William R. Leigh, Robert H. Rockwell, Ludwig Ferraglio, whose sculptures have been exhibited in the National Academy, F. Lee Jaques, widely recognized as the finest bird artist in America, with many exhibitions to his credit, Vincent Narahara and many others of national reputation.

Although not executed by the Preparation Department, the Coral Group, in the Hall of Ocean Life, presented one of the most unique and difficult problems in preparation and engineering. You may have stood before this reproduction of a coral reef in the Bahamas to admire its sheer beauty or to study it with a scientific eye but perhaps it would have been even more interesting if you had witnessed its construction behind that door. To the visitor this Coral Group—the first ever to be installed in any museum—appears to have been brought to life intact instead of requiring twelve years of complicated and difficult work.

Non-floating paint brushes

Dr. Roy W. Miner led five expeditions to the Bahamas to make the studies and collections for this group. Twelve hundred still pictures were taken, four thousand feet of motion picture film and seventy colored sketches. The latter were made by the artist Chris Olsen who worked undersea in a diving helmet. All of his equipment had to be weighted—to let go of a paint brush meant it would promptly float to the top. The coral itself was collected, bleached and packed in four weeks. To bleach the coral it was laid on the beach and water poured over it constantly to wash off all material clinging to it and then left in the sun to dry. Three thousand square feet of lumber were used for packing.

As there was no precedent for making such an exhibit, many original problems in engineering and technique had to be solved by patient experiment and ingenuity on the parts of Doctor Miner and Mr. Chris Olsen. One of the most difficult to overcome was the problem of disguising the steel construction where the coral did not cover it and at the same time not destroy the translucent appearance of water. A great variety of materials had been tried and found unsatisfactory when one day, as a joke, a friend of Mr. Olsen's presented him with a roll of a cellophane and wire mesh combination, used by farmers for the windows of chicken coops. It proved to be the perfect solution.

Few visitors to the Insect Life Hall realize the interesting work that is carried on "behind that door" to maintain the living insect exhibit. Live insects, like humans, have to eat. As their diet consists mainly of other insects, a veritable incubator and nursery is necessary to preserve this endless chain. Here, cockroaches and crickets are raised on bran; slices of potatos and apples serve as food for the tarantulas. Flower beetles, which are fed on dog biscuits and whole wheat flour, become in turn food for other insects. The praying mantis, which is raised for exhibition, prefers live flies and meal worms. To make the meal worm appear more lively and therefore more tempting to the mantis, he is dangled on the end of a piece of thread like a marionette. The tarantulas are perhaps the most spectacular and hardy of these charges. One of them has been living in the Museum for more than nine years, apparently satisfied with his hand-raised diet but without visible improvement in disposition.

Every department has its problems behind the scenes which the visitor seldom suspects. When we read of people being prostrated by a heat wave we hardly think of insects as being similarly affected. And yet, a particularly hot spell last July raised havoc with the "nursery." Many of the inmates died and others became sickly. The bees that are kept on exhibition give the least trouble unless something unusual happens. In winter they are fed sugar syrup but in summer a panel in the wall adjoining their case is left open so that they can forage for themselves in the City's parks. However, occasionally an emergency arises as when recently several days of damp weather caused the wooden frame of the case to warp. A steady stream of bees flew out into the Hall through the crack between the frame and the glass side of the case and were captured with difficulty.

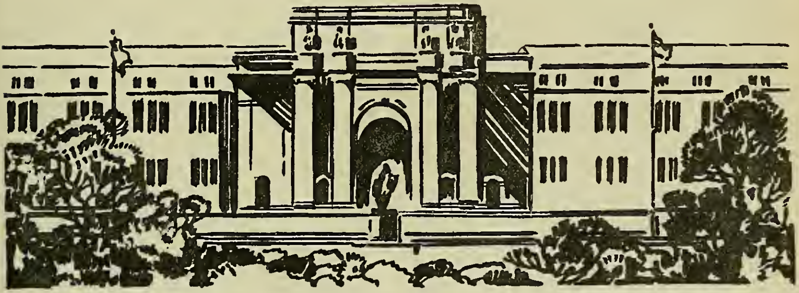
The living insect exhibits not only play an important part in the educational work of the Museum but they form the basis of study for airplane designers, commercial artists (an advertising firm, handling the advertising for a nationally known insecticide, recently sent a representative to study the living insects), textile manufacturers as well as students of natural science.

But even more important to the work of the Museum are the living animals maintained, not for exhibition, but for study and experiment by the Department of Experimental Biology. Step into the huge elevator at the end of the African Building, an elevator designed to carry such objects as mounted elephants, and ascend to the roof. There you will find a series of what appear to be greenhouses with the warm, humid atmosphere of Malaysia or Brazil. Rows of aquariums filled with exotic looking fish; glass cases in which close scrutiny reveals the sharp eyes of a lizard or snake between the leaves of tropical plants; cages of frogs, rats and other small animals fill a large part of the glassed enclosure. Under the direction of Dr. G. K. Noble, these living creatures are studied for their habits, their reactions under varying conditions and for what light they may throw on the still existing mysteries concerning man himself.

Every now and then the Department receives an uninvited guest, as happened one day last spring. A live snake was discovered in a

ENTRANCE, ROOSEVELT MEMORIAL

Drawn by Joseph M. Guerry



small traveling case that had been deposited on a refuse can in the neighborhood. The astonished apartment house superintendent who found it, not knowing what else to do with it, brought it to the Museum where it was given temporary shelter in the Experimental Laboratory. Three days later an article appeared in a newspaper stating that a professional dancer had mislaid the pet snake which played an important part in her act. The lady was notified and the snake returned to its rightful owner.

740,000 birds

Research is a vital function of every scientific department of the Museum, and the Department of Ornithology maintains an entire building for the purpose of research and study, not only for its own large staff, but for visiting scientists and students. A fact that the average layman may be unaware of is that birds mounted and kept in cases are lost to science because their color fades and they cannot be handled and studied. The new Whitney Wing of the American Museum of Natural History now contains the largest collection of birds for study in the world. Forty-eight years ago the collection comprised 300 birds. It now has 740,000. These are kept in series of trays in special modern, insect-proof cases that close with pressure against rubber to keep out moisture, vermin and dust.

On each floor are special work rooms for visiting ornithologists as well as the offices and laboratories of the staff. To the Whitney Wing also come textile designers of automobile upholstery, ribbons and other fabrics to study the bird skins for new colors and patterns. What appears to the casual observer to be a monotonous warehouse of white enameled cases becomes an exciting experience when he is taken behind that door for a glimpse—with even "an uninitiated eye"—at how these unmounted birds are used to unfold the secrets of migration, environmental influence and variation, to add to our knowledge of the life history of the world.

The Department of Anthropology, of which Dr. Clark Wissler is Curator, can exhibit only a fraction of its thousands of specimens relating to Man and his development and history. One must go "behind that door" to visit the unique "library" where thirteen thousand human skulls, representing the natives of every part of the world, are filed for research in labelled boxes and arranged like books on a library shelf; or to the room of life masks, where shelf after shelf contains the plaster likenesses of every race and type. Among those who come to study the research collections are surgeons, dentists, specialists in pediatrics and sinus ailments as well as anthropologist and students of anatomy. Maintained for research, also, are the library of specially recorded victrola records of native tribal music and rooms containing the implements, pottery, clothing and ornaments of the primitive peoples of the earth. The latter have specially designed doors and, as a precaution against insects, are periodically filled with poison gas, which is allowed to remain for several hours and pumped out.

So much of the work of this Department is conducted behind the scenes that few may realize the infinite amount of patience and labor involved in the making of an accurate model of a Mayan temple, a miniature life group of natives, or the restoration of a pottery urn that was found in a hundred scattered fragments. It is in the workrooms "behind that door" that these bits are pieced together and the models made.

Animals great and small

No less interesting are the research workrooms of the Department of Mammalogy, presided over by Dr. Harold E. Anthony and the members of his staff. Here the skulls, skeletons and skins of mammals—from the tiniest shrew to the full-grown elephant—are stored and catalogued for study. There are one hundred thousand complete specimens in all. From twenty to thirty of each species are necessary for making scientific comparisons. The student who wishes to study the development of the tusk formation in elephants may compare thirty specimens of all ages, from a newly born elephant to the fully mature animal. Many of the smaller mammals are also preserved in alcohol for study of the soft parts.

From this Department advice and information is often sought by furriers, glove manufacturers and other commercial firms as well as students of science. Wholesale furriers bring in samples of fur for identification. Usually, although head, feet and other distinguishing features are missing, the scientist has little difficulty in determining their origin. In one case recently, however, a real problem was presented by a sample of a consignment of furs which was finally proved to be unborn reindeer. Others, manufacturers of imitation fur, come to study and photograph patterns which may be copied in plush and other fabrics and many seek information regarding the abundance of fur-bearing animals in different parts of the world.

At the end of a long hall in the main building is the office of Dr. Chester A. Reeds, Curator of Geology. This Department is constantly being asked for advice and assistance by the public. During the construction of the huge piers on the west shore of Manhattan Island for the Queen Mary and Normandie, when slides occurred, Doctor Reeds was called in consultation. Every day's mail brings samples of rock or meteor for identification, requests for information and applications for employment. One of the latter recently lightened the day's labor. A college student wrote that she would like to be "the Curator and Librarian of the American Museum of Natural History" and wanted to know how she should go about preparing for the position. One of the many problems of this Department is the misunderstanding of its work in the field by property owners. In taking samples from a clap pit in New Jersey, it was necessary to make test holes in the bottom of the pit to determine the depth of the clay. Some time later the owners had several feet of clay dug from the bottom of the pit and as it was below sea level it promptly filled with water. It required a great deal of explaining to convince the owner that the geologist's activities were not responsible for the flooding of the pit.

The "Drama of the Skies"

Not only the world we live in but the universe surrounding it comes within the scope of the Museum. Since it was opened to the public in October, 1935, more than seven hundred thousand people have witnessed the "Drama of the Skies" in the Hayden Planetarium which is both a theater and a school for those who are interested in astronomy. In spite of the great number of people who come to witness the magic of an invention that can accurately reproduce the skies as they appeared to the Wise Men of Judea or as they will appear to our great-great-grandchildren, an increasing activity is developing behind the scenes. The Hayden Planetarium Bulletin, the official publication of the Planetarium, dealing with Astronomy, has grown from a slim pamphlet into a mature, full-sized magazine. The periodic, national radio broadcast brings enthusiastic letters from every part of the United States and Canada. And the Junior Astronomy Club is becoming known throughout the country. Its members have already taken an important place in astronomical circles. A member of the Student Science Clubs of America with headquarters at Pennsylvania State College, the Junior Astronomy Club has its club room in the Planetarium building. It is one of the many features of the Museum that takes place behind that door.

Exploration

There is probably no single branch of the Museum work as interesting to the public as its expeditions. Aside from the great scientific value of collecting specimens and studying their environment at first hand, exploration has a magic appeal to the adventurous and unadventurous alike. The first organized expedition sent out by the Museum was one from the Department of Mammals and Birds in 1886, when Dr. Daniel G. Elliot and Jenness Richardson went to Montana in search of material for the Bison Group. In the past two years the American Museum of Natural History has sent out more than forty-eight expeditions to all parts of the world. Among others, the Vernay-Hopwood expedition expored Burma and Malaysia for rare specimens and a motion picture record of the gibbon. The Templeton Crocker expedition, in the yacht, "Zaca," sailed the South Seas to study the background of the Polynesians. The Sage expedition brought home the giant panda from West China and Dr. Barnum Brown flew twenty thousand miles over the Western United States to make an aerial survey for traces of prehistoric life.

The big game scientific expedition differs from the sportsman's hunting expedition in many respects. The scientific expeditionary party usually includes a geologist, artists, photographers, taxidermist as well as hunters and the native guides and porters. The motor truck has largely replaced the great number of native porters that formerly were necessary. The game to be shot is carefully selected so as to get perfect specimen animals and the skins are brought home, not as trophies, but to be mounted for scientific exhibition and study. Here are just a few of the items of expense connected with such an expedition to Africa. A one way passage to Nairobi, the headquarters for most African big game hunting, costs approximately one thousand dollars. And that is only the beginning. To hunt lions, zebra and antelope there is a license fee of five hundred dollars for each gun. To shoot an elephant in its native jungle, the hunter must pay an additional one hundred dollars. Guides cost about two thousand dollars a month, depending upon the size of the party, for each individual in the expedition. Their charge includes the supplying of native porters, food and automobiles. The type of gun used for killing elephants costs in the neighborhood of five hundred dollars. In many countries the shooting of game is now highly restricted and all sorts of permits are necessary. Many animals are fast becoming extinct through the encroachment of civilization. Their preservation in such institutions as the American Museum is highly important to the scientific education of future generations.

To pass on to the public the information it gains through research, experiment and exploration is one of the primary functions of the Museum. As the late Professor Osborn said, "It is not enough that scientists should know. It is important that people should know." Through its scientific papers, Publicity Bureau, Natural History Magazine—a subscription to which is included in every membership in the Museum—other popular publications and its Department of Education, the Museum maintains a constant flow of outgoing information into every state in the Union and most of the civilized countries of the world. The work of its Department of Education alone, is so vast that it would require an entire volume to describe what takes place behind that door. When the distribution of nature study collections and photographic slides was begun in the early part of the century it required the services of one messenger. As the Department increased its scope, a horse-drawn wagon was hired from a nearby livery stable. Today, the Museum keeps seven automobile trucks in constant operation to deliver its educational material in New York City alone. Outside of New York, photographic material, including still and motion pictures, was sent to forty-one states, Alaska and eight foreign countries during the past year.

The name of General Goethals will go down in history as the builder of the Panama Canal. But every man who wielded a pickax or interpreted a blue print was vitally necessary to is accomplishment. The American Museum of Natural History is playing an important part in the enlightenment of the world in the science of natural history. It could not do so without the loyal co-operation it has received from its members. Every member, whether an associate member or an endowment member, is contributing his bit to the progress of civilization.

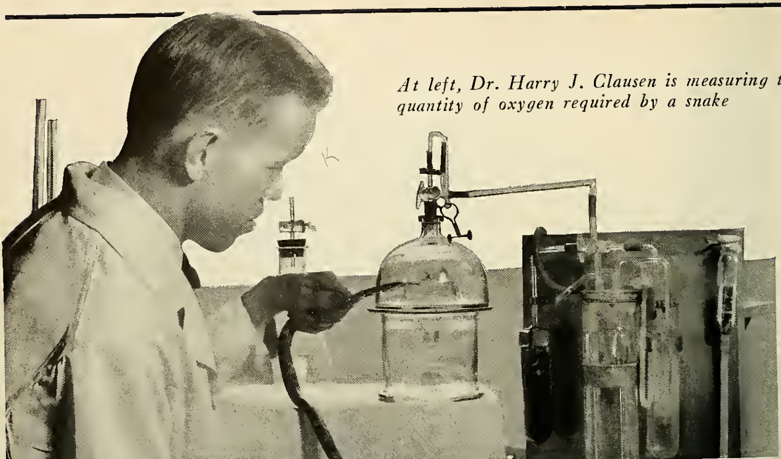
SOUTH FAÇADE, AMERICAN MUSEUM

Drawn by Joseph M. Guerry

Behind that Door

The American Museum of Natural History invites its members to inspect the veritable village of nearly a thousand people who labor "behind the scenes" to the end that science may be advanced and interpreted to the public

At left, Dr. Harry J. Clausen is measuring the quantity of oxygen required by a snake



A wide variety of foods must be stocked to suit the dietary habits of the laboratory's inmates. (Above) White worms being fed to fish under observation

Tice

(Above) Breaking a hunger strike: force-feeding a snake who refuses dead food

(Right) Pampered inmates. The overhead pipes provide each table with ice water, hot water, and water of controlled temperature

In the American Museum's Department of Experimental Biology, under the direction of Dr. G. K. Noble, living animals are kept for the study of their habits and reactions under varying conditions

(Below) A lunch of earthworms for terrapin

(Above) An interested spectator in the Department of Experimental Biology

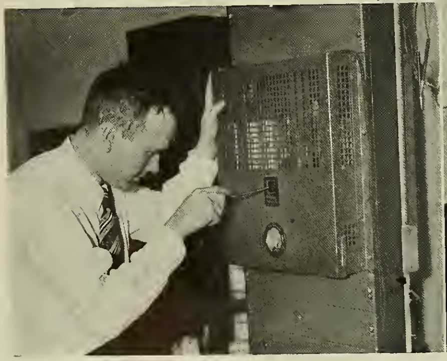
(Left) Water babies: An experimental tadpole in each dish, studied under uniform temperature

(Right) A Museum carpenter. A force of fourteen are kept busy making furniture, picture frames, cases, and other appurtenances

(Below) Machinery whirrs in the Museum workshop. Special apparatus for the curators is here constructed in addition to the extensive repair work that is done

Music of the spheres: mechanical overture produced behind the scenes for the appearance of the stars in the Hayden Planetarium

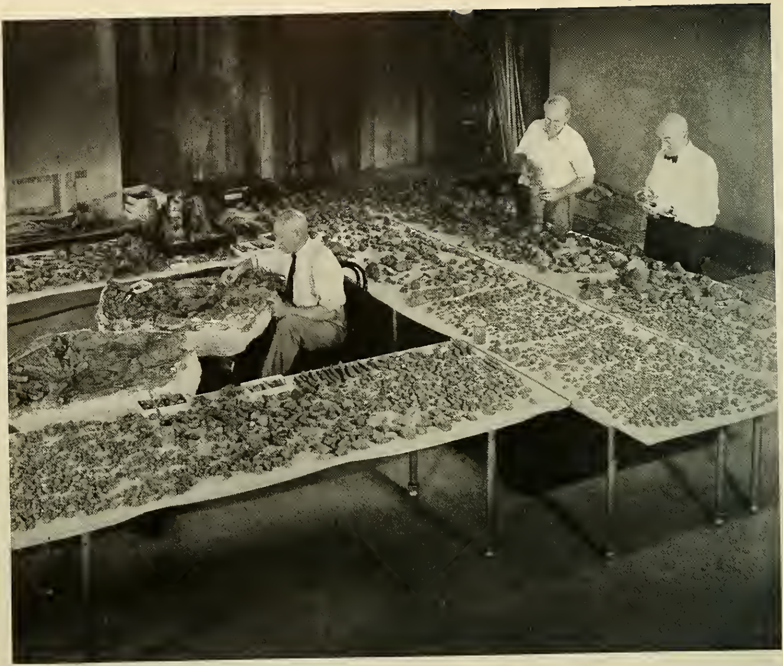
(Below) Fred Raiser testing for perfect reproduction



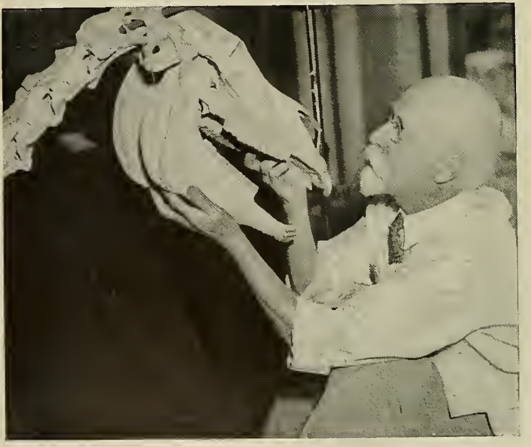
(Left) Storing fur "coats": T. Donald Carter of the scientific staff hanging skins in moth-proof cases. Whole dead animals are frozen solid in life-like poses in a large refrigeration room for study by staff sculptors

Mounting a cormorant: Raymond B. Potter, one of many experts constantly striving to improve the methods of taxidermy

(Below) President F. Trubee Davison examining one of the 740,000 bird specimens which make the Museum's collection the largest for study in the world



(Above) A jig-saw puzzle in animal history: fragments from which an extinct creature will be reborn, illustrating the complexity of the task which confronts Dr. Barnum Brown (right) and his assistants when a shipment is brought back from the field



(Left) The skeleton of a mountain zebra takes form under the skilful hands of S. H. Chubb, Associate Curator in Comparative and Human Anatomy

(Right) A prehistoric clue is analyzed through the microscope: Albert Thomson preparing the jaw of an ancient mammal. Experience is the only school in this work, and many of the men engaged in it have been developing their methods for more than thirty years in the American Museum

(Right) One stage in the reproduction of an extinct animal: Otto Falkenbach piecing together the skeleton of a fossil reptile

(Below) Shark in plaster

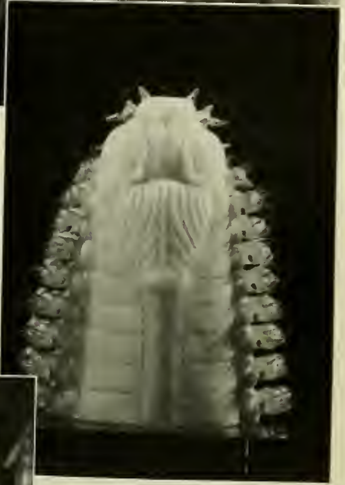
"Are the trees and flowers in the groups real?" visitors frequently ask. Some are, but Museum artists can reproduce them so accurately that they cannot be distinguished from the real objects and last much longer. At left you see G. Frederick Mason, whose cover designs are familiar to NATURAL HISTORY *readers, turning his hand to the making of an artificial cactus*

Birch bark industry in miniature: Mr. Narahara mak- (cont. below)

ing one of the interesting models of native life produced by the Department of Anthropology, under the direction of Dr. Clark Wissler

(Right) Fish that never swam. But in the Coral Reef Group, where they were put after Bruce Brunner completed them, many mistake them for real ones

As many as a thousand artificial flowers are sometimes made for a single habitat group. Leaves are even more numerous, there being a hundred thousand in a single exhibit



(Above) Microscopic anatomy rendered in blown glass: a small marine worm reproduced on a grand scale. (Left) The glass blower at work: Herman Mueller, who has pursued his distinctive art for more than forty years in the American Museum

The Museum library, one of the many resources open to members of the largest institution of its kind in the world

Here one may see such well-known explorers as Byrd, Beebe, Ellsworth and others. Writers, artists, motion-picture producers and research workers from commercial firms also make use of its 119,000 volumes

The Eclipse in Kazakhstan

Eye-witness account by the American Museum's representative, who traveled 16,000 miles to study a spectacle lasting less than two minutes

By CLYDE FISHER

Curator, Astronomy and the Hayden Planetarium, American Museum

BY early dawn—and dawn comes early on June 19th, in latitude 51 degrees North—there was a stir of quiet activity in the various units of the expedition, making the last tests of focus and performance of instruments. At first the sky was partly cloudy, causing much uneasiness, especially on the part of those who had traveled half-way around the world to observe the eclipse. In the course of a few hours, however, the eastern part of the sky, where the sun would be located for us, became entirely clear, much to our relief.

Effect on man and animals

Exactly at 8:11 a. m. local time, as computed by a member of our party, Mrs. Isabel M. Lewis, of the U. S. Naval Observatory, the moon's disk made the first contact on its trip across the face of the sun. Since the moon revolves around the earth from west to east, the eastern edge of its disk first contacts the western edge of the sun's disk. In a little more than an hour the moon had moved entirely between us and the sun. As the sun's crescent became thinner and thinner, a weird darkness came on, a phenomenon which affects both man and animals. It is practically certain that the chorus of bird-songs, which we had enjoyed for many days around our eclipse camp ceased temporarily, that the ever-present skylarks suspended their ecstatic flight-songs—but I am sure that no member of our expedition had time to observe the behavior of either man or animals.

The ghostly and elusive shadow-bands, which usually appear a few minutes before and after totality, were not pronounced. I had seen them well on the snow at the eclipse of January, 1925, and was watching for their appearance here. At two minutes before totality I took my last look for them on the walls of our white-canvas optical tent nearby, and did not see them. They were observed, however, by Dr. Donald H. Menzel and by Mr. J. A. Pierce.

Weird twilight

The darkness increased and delicate colors developed. The dark purple of the rolling steppes to the westward just before totality was unforgettable. The sky became dark greenish-blue, with a band of salmon-orange just above the horizon. Just as the last bit of the sun was covered, and with great suddenness, the finest spectacle ever observed by man was before us. The exquisite corona, generally considered the most beautiful feature of an eclipse of the sun, became visible as a five-pointed star with very long streamers, probably interpreted by many inhabitants of the U.S.S.R. as a symbol of the Soviet star. As expected the corona approached the sunspot maximum type, in which the polar and lateral streamers are of about equal length.

At the base of the corona, unusually high prominences could be noted with the unaided eye; at least six could be counted, one of which must have been nearly 100,000 miles in height; two large ones were so close together that they might have been regarded as a double prominence.

Venus shone out brilliantly about two degrees above the sun and a little to the right, adding much to the spectacle. Mars, though much fainter than Venus, was seen to the left of Venus and closer to the sun.

The Baily's Beads, produced at the beginning of totality by the last rays of the sun shining between mountains or other irregularities of the moon's surface, and at the end of totality by the first rays of the sun shining through such irregularities, were especially fine at the end of totality, giving the gorgeous "diamond-ring" effect.

A few months before the eclipse of June 19, 1936, I was invited to join the Harvard-M. I. T. Expedition by Dr. Harlow Shapley, Director of the Harvard Observatory, seconded by Dr. Donald H. Menzel, also of the Harvard Observatory, who was to be leader of the expedition.* My acceptance of this attractive invitation was made possible by the generosity of Mr. Charles Hayden, godfather of the Hayden Planetarium.

The path of totality extended from a point in the Mediterranean Sea off the southwest coast of Grecian Pelaponnesus, where the eclipse began at sunrise, thence across Greece, European and Asiatic Russia, Siberia, Northern Japan, and out into the Pacific Ocean, where the eclipse ended at sunset.

On Asia's steppes

The station selected for the Harvard-M. I. T. Expedition was located on the Kirghiz Steppe in Kazakhstan in west-central Asia, nine miles east of Ak-Bulak, a town of 9000 inhabitants. The homes here are low, one-story houses made of adobe bricks and with adobe roofs—a quaint old town with very wide streets. Here are to be seen more ox-carts and camels than automobiles. In fact, the entire water supply of our camp was hauled by a Siberian camel complaining every step of the way. The actual eclipse camp was situated upon an ancient Chude burial mound, which gave a fine outlook over this rolling steppe country. Since Ak-Bulak is not shown on most maps, it may be well to state that it is located southeast of Orenburg, home of the famous Orenburg Shawls.

The similarity between this steppe country and the Great Plains of the Dakotas is striking, and the summertime weather is much the same, that is, extremely continental. The mornings are usually clear, but toward noon or especially in the afternoon, light-colored cumulus clouds appear, having been formed *in situ,* becoming more and more abundant—beautiful for photographic effects, but distressing if they should cover the sun at eclipse time. So, it was fortunate that the western end of the long path of totality was chosen as our location, for here the eclipse occurred in mid-forenoon (totality lasting from 9 hr. 15 min. 20 sec. to 9 hr. 17 min. 17 sec., local time), not only a good time of day for the probability of clear skies, but also a good elevation for astronomical observation. In fact, out of *six* mornings immediately preceding the eclipse, *four* were perfect for observation. For a period of two or three weeks just before the eclipse, the record was much more promising.

Many expeditions

On adjoining ground was located the principal expedition from the Poulkovo Observatory near Leningrad, under the leadership of Professor B. P. Gerasimovich. The Poulkovo Observatory also had a branch expedition located near Omsk. Professor Gerasimovich, who spent a few years at the Harvard Observatory, is not only director of the leading observatory in the U.S.S.R., but he was assigned by the Soviet Academy of Sciences to arrange for all the expeditions in his country. Hence, it may be said, that we were close to headquarters, and the proximity to Professor Gerasimovich and his expedition added much to the pleasure and profit of our work.

Forty expeditions were scattered along the path of totality in the Soviet Union alone, of which 28 were from the U.S.S.R., and twelve were foreign. The latter included two

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*The entire personnel of the expedition was as follows:
Dr. and Mrs. Donald H. Menzel of Harvard,
Dr. and Mrs. Joseph P. Boyce of Massachusetts Institute of Technology,
Mr. Henry Hemmendinger of Harvard,
Miss Henrietta Swope of Harvard,
Mr. and Mrs. A. H. Benfield of Cambridge, England,
Dr. and Mrs. R. D'E. Atkinson of Rutgers University,
Dr. and Mrs. Wallace R. Brode of Ohio State University,
Miss Catherine Stillman of Vassar College,
Dr. and Mrs. I. C. Gardner of the Bureau of Standards,
Mr. Paul King of the Cruft Laboratory of Harvard University,
Mr. H. Selvidge of the Cruft Laboratory of Harvard University,
Mr. J. A. Pierce of the Cruft Laboratory of Harvard University,
Mr. E. P. York, of the Cruft Laboratory of Harvard University,
Mr. Jackson H. Cook of Massachusetts Institute of Technology,
Miss Marguerite O'L. Crowe of New York State Board of Health,
Mrs. Isabel M. Lewis of U. S. Naval Observatory,
Mrs. Lucy T. Day of U. S. Naval Observatory,
Dr. Clyde Fisher of the Hayden Planetarium of the American Museum of Natural History.

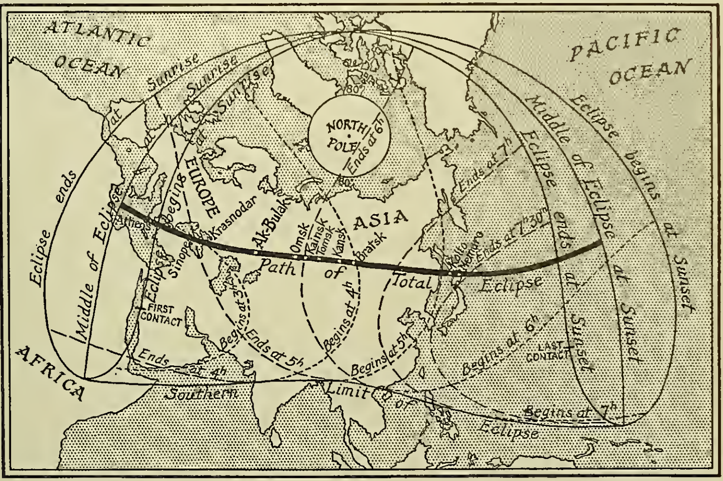
from America—the Harvard-M. I. T. and the Georgetown University-National Geographic Society—French, British, Italian, Polish, Czechoslovakian, Dutch, Swedish, and Chinese. There were other expeditions in Japan. We were extremely sorry to learn that the Georgetown University-National Geographic Society Expedition, which was located at Kustenai, Kazakhstan, was frustrated by clouds.

Most of the work of the Harvard-M. I. T. Expedition was spectrographic in character, and the results can not be known for months. In fact, the results of most of the expeditions can not be known for a long time. About all that can be said at the present time is that most of the parties had a perfect opportunity.

The Soviet expeditions, which were scattered from European Russia to Eastern Siberia made definite plans to study possible changes in the corona during the sweep of the eclipse eastward along its path. Although such studies had been attempted before, they had never been made with exactly the same kind of instruments, using the same kind of plates, to be developed under the same conditions.

Results of the test of the Einstein Effect will be awaited with interest by many astronomers, for there are still some scientists who feel that the test of the bending of the rays of light from the stars when passing near the sun has not been satisfactorily met. Professor A. A. Mikhailov of the Sternberg Astronomical Institute of Moscow had charge of this work. He had clear skies in Khabarovsk Province, and made photographs of the star-field around the sun, with his camera of original design which will, it is hoped, make possible the elimination of the errors that arose in previous observations. Eight months later after the sun has moved to another part of the sky, Professor Mikhailov plans to photograph the same star-field for comparison.

K. N. Shistovsky, Technical Director of the Moscow Planetarium, planned to fly to an altitude of 10,000 meters in a sub-stratosphere



By D. F. Levett Bradley
Adapted from U. S. Naval Observatory map

EXTENT OF ECLIPSE

The heavy line shows the regions where the eclipse was total. It was from the town of Ak-Bulak that the American Museum's observer, Dr. Clyde Fisher, studied the spectacle. The dotted and dashed lines indicate the hour (Greenwich Civil Time) at which the eclipse began and ended in various parts of Asia and Europe balloon, at the village of Otrada Kubanskawa, North Caucasus. His objects were to photograph the on-coming shadow of the moon with a motion-picture camera, and to make spectrograms of the flash-spectrum and corona. When I talked with him about his project before the eclipse at the Moscow Planetarium, he was much interested to know that I had photographed the on-coming shadow of the moon with the Akeley motion-picture camera at the eclipse of 1932. Although I have not yet heard what results Mr. Shistovsky secured, I should expect much from him. He is a very able and resourceful technician, having invented several outstanding accessories for the Moscow Planetarium, namely, the sunrise-after-dawn device, the twinkling-star apparatus, the strip-map for use in changing latitude, the Northern Lights device, and a solar-eclipse apparatus.

Animal behavior

So far as I know the first organized and directed project for the observation of the behavior of animals during an eclipse, was carried out by members of the Young Naturalist's Clubs of the schools with the cooperation of Professor P. A. Manteufel, Director of the Moscow Zoo. The preliminary results of these observations, which have been reported by the press, have brought many communications on the subject from various parts of the U.S.S.R. Professor Manteufel, who is a trained research scientist as well as a lover of animals, will edit these and publish a paper on the subject.

While in Moscow on my return from Asia, I attended a motion picture theatre in order to see the Soviet news-reel of the Eclipse, which I understood was being shown throughout the U.S.S.R. I knew that it had been made at Ak-Bulak, but imagine my surprise when the picture opened with Clyde Fisher cranking the Akeley Camera! In fact, this photo-naturalist appeared in the picture in three different places. And the Explorers Club flag showed up finely.

The Academy of Sciences of the Soviet Union is to be congratulated upon its most extensive educational campaign in connection with the eclipse, which was so thoroughly promoted and carried out. Every member of the Harvard-M. I. T. Eclipse Expedition owes a debt of gratitude to the Acadamy of Sciences and to Professor B. P. Gerasimovich for their generous and untiring help in making our project a success.

One of the amazing discoveries made before the dawn of history by the ancient Chaldean watchers of the sky was that eclipses occur in cycles, the series repeating itself every eighteen and a fraction years, this period having been named by them the *Saros,* signifying repetition, and by this name it is still known to astronomers. Thus it has long been possible to forecast eclipses with considerable accuracy, though not with the refined accuracy with which it is now done by the Nautical Almanac Office of the U. S. Naval Observatory and by similar agencies in other countries.

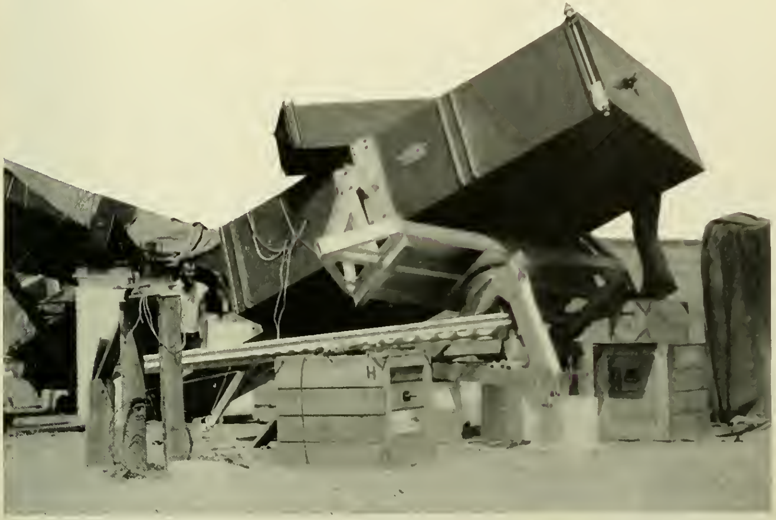
An eclipse can occur only at the new moon phase when the moon is at or near one of its nodes, that is, one of the two points of intersection of the moon's orbit and the plane of the ecliptic. These two points or nodes, however, do not stay put, but travel westward, in a slow precessional movement which carries them clear around the sky in eighteen and a fraction years, and this determines the length of the Saros, or Eclipse Cycle. The exact length of the Saros is not an integral number of years and days, but is eighteen years, eleven and one-third days (or ten and one-third days, if the interval contains five leap-years). The one-third of a day allows the earth to turn one-third way around on its axis, and this makes the corresponding eclipse of the next Saros take place about 120 degrees west of its previous counterpart. Consequently it will require three of these Saros periods, or a little more than fifty-four years, before we have another total eclipse of the sun in this part of the world.

Eclipse next year

After three Saros periods have passed, that is, on July 22, 1990, as calculated by the eclipse wizard, Oppolzer, we shall have a total eclipse of the sun visible in almost exactly the same longitude, although farther north in latitude. While it may be a little early to plan expeditions to this one, astronomers are already looking forward to the total eclipse of next year—June 8, 1937—the path of totality spanning almost the entire breadth of the Pacific Ocean and ending in Peru. This eclipse, which will last seven minutes and four seconds, will be unusual in that the period of totality will be very nearly the longest possible.

The Eclipse in Kazakhstan

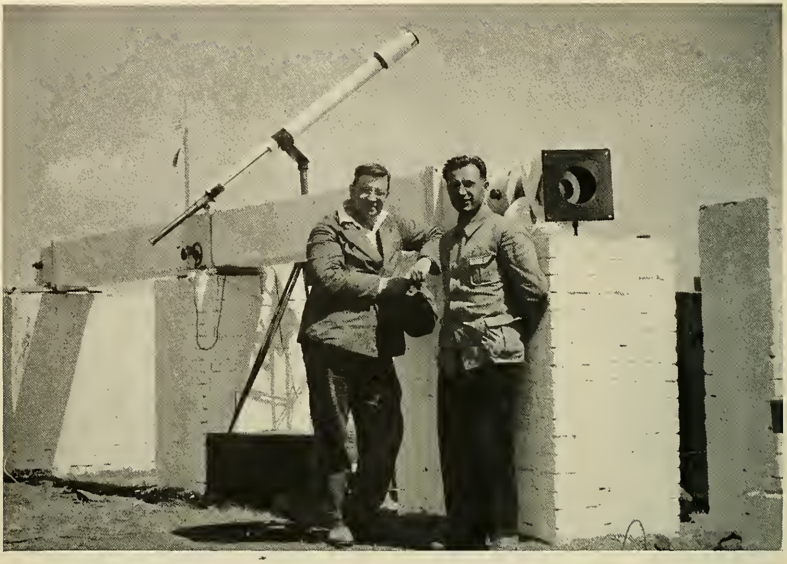
The first publication of photographs taken by Dr. Clyde Fisher of scenes in and about the camp in Asiatic Russia where the Harvard-M. I. T. and the leading Soviet expeditions studied the most recent total eclipse of the sun



(Above) The "Snow-plow," a multiple spectograph of the Harvard College Observatory, a most efficient instrument used in determining the composition of the sun and the state of its elements

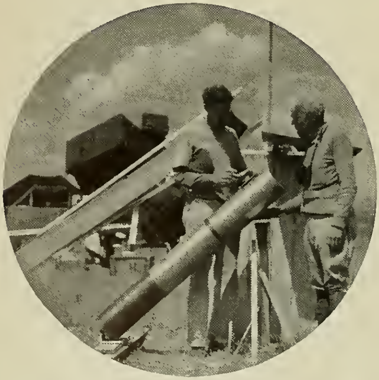
(Below, left) A last-minute conference with the leaders: Dr. B. P. Gerasimovich, Dr. Clyde Fisher, and Dr. Donald H. Menzel

(Below, right) Dr. Wallace Brode of Ohio State University photographing the flash-spectrum, the spectrograph covered with a tent

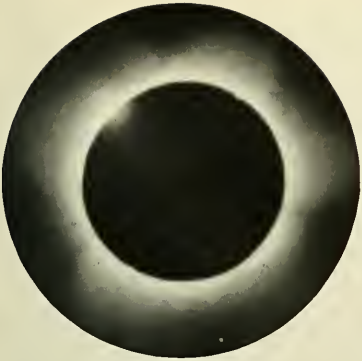


(Above) Professor Eugene Perepelkin and associate with the fine horizontal telescope of the Poulkovo Observatory. Above the larger instrument a small Zeiss refracting telescope, also used by the Soviet Expedition, can be seen. The Russian Government showed considerable interest in the eclipse. News-reels taken at the camp were shown all over the country

(Below) Professor M. Navashin, of the University of Moscow, and Dr. Clyde Fisher examining a reflecting telescope made by the former. The photograph of the corona on page 209 was secured with this home-made instrument

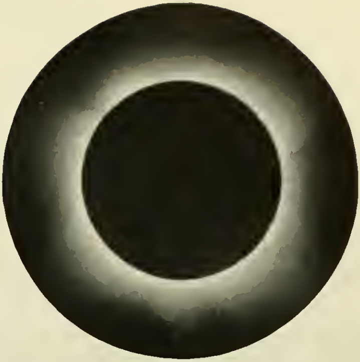


(Below) Dr. Irvine C. Gardner, of the Bureau of Standards, setting up his telescope with which he made color-photographs of the eclipse

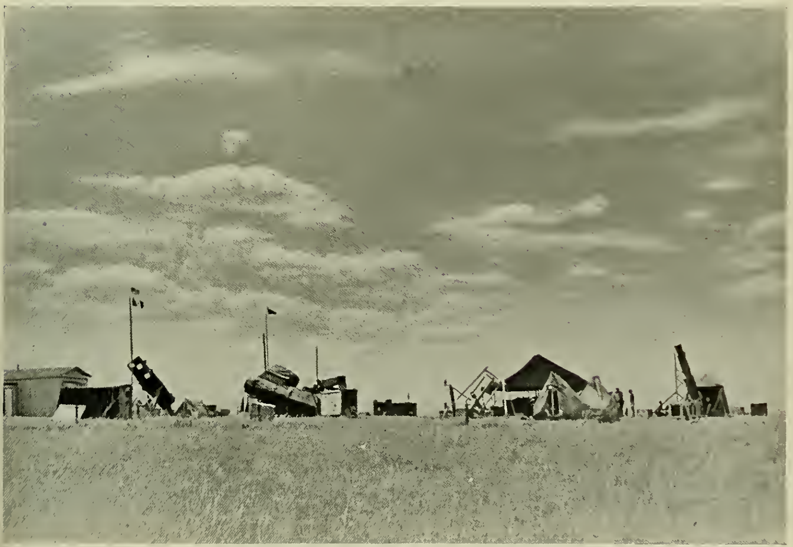


Harvard College Observatory Photo

(Above) The famous "diamond-ring" effect, here shown an instant before the moon has completely covered the sun

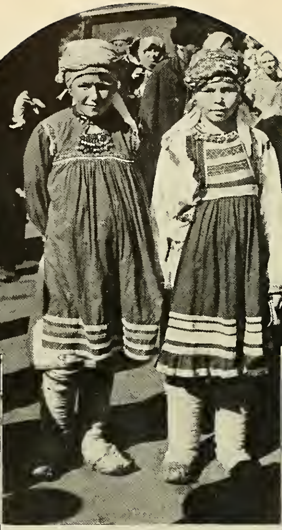


(Above) Photograph by Professor M. Navashin of the inner corona together with unusually high solar prominences which were visible when the moon moved completely between us and the sun



(Above) The Eclipse-camp, showing from left to right, photographic laboratory, radio-shack, "Quadruped" (multiple spectrograph), "Snowplow" (multiple spectrograph) telescope used by Miss Swope, spectrograph used by Doctor Brode, and Doctor Gardner's telescope

(Right) Two little maids from school: Mordvin Russian girls in national costume. Note the heavy "putties"



(Below) Russian couple en voiture. *Their horse resembles the Mongolian wild horse*

(Above) Mordvin mother and child

(Below) Water supply and lumber are provided by time-honored methods

(Above) Russian peasant coating her house with a layer of adobe, a sort of stucco similar to that used by our own Pueblo Indians of the American Southwest

(Left) Clyde Fisher showing his Akeley camera to the leader of the Poulkovo Expedition

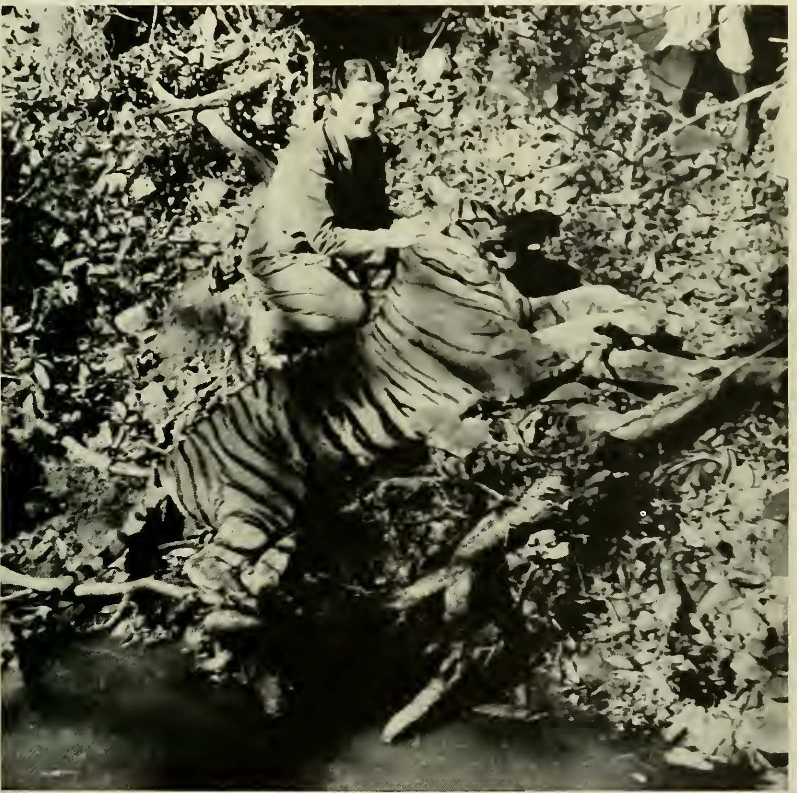
(Above, center) Miss Henrietta Swope on camel-back chatting with Professor B. P. Gerasimovich

Through India

A Journey in Pictures by Mr. and Mrs. F. Trubee Davison

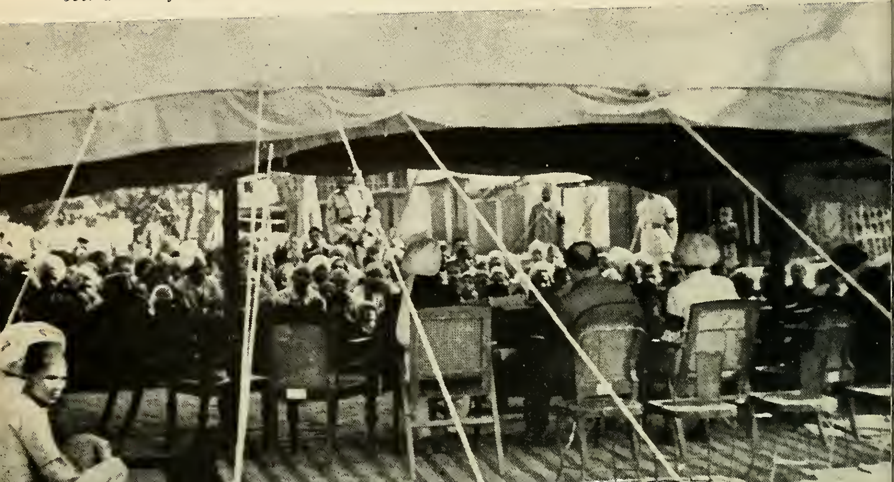
Mr. and Mrs. F. Trubee Davison recently returned from an expedition to India and Nepal for the American Museum of Natural History. This was made possible through the courtesy and assistance of Mr. Arthur S. Vernay, Trustee of the Museum. Mr. and Mrs. Davison made the trip from Italy and return by airplane over the Imperial Airways System. The route goes across the Mediterranean to Alexandria, then east through Palestine to Bagdad, south along the west coast of the Persian Gulf, and then east again along the southern coast of Persia to India

Collections for the Museum were made in the United Provinces through the kindness of Mr. Donald Stewart, Forest Officer, and also with the able assistance of Major James E. Corbett; in Nepal through the kindness of His Highness, the Maharajah, and His Excellency, the British Minister, Lt.-Col. F. M. Bailey, C. I. E.; while in Mysore and Madras Ralph Morris assisted Mr. and Mrs. Davison



(Above) Mrs. Davison with a tigress which she shot for the Museum's collection. The tigress was crossing a stream and sank upon being struck. Here the animal is shown as it was being dragged from the river by the natives

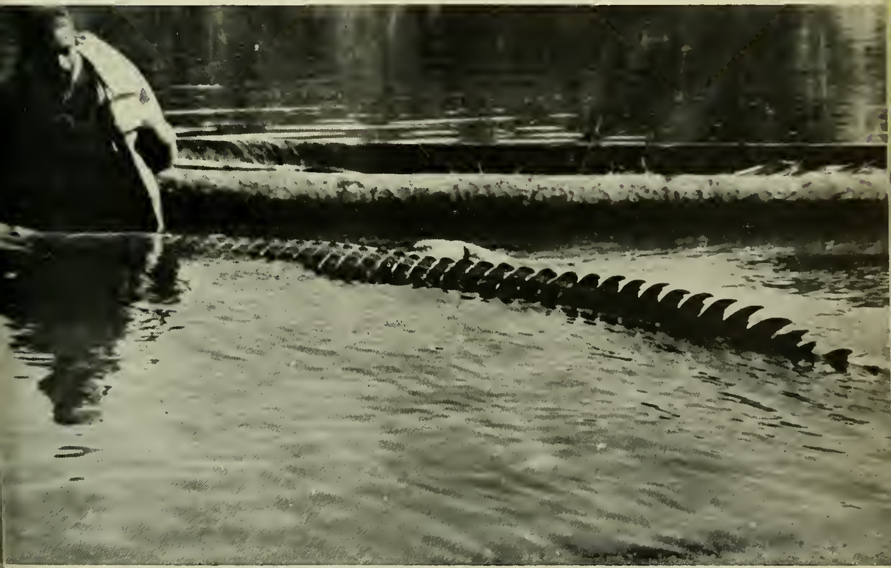
A memorial service for King George V in the jungle. While the Davisons were in the interior, word of the King's death was received over a battery radio set. Captain Ibbotson, the District Commissioner, arranged the memorial service shown below, and can be seen with his back to the camera, flanked by the local Hindu priest and the Mohammedan priest



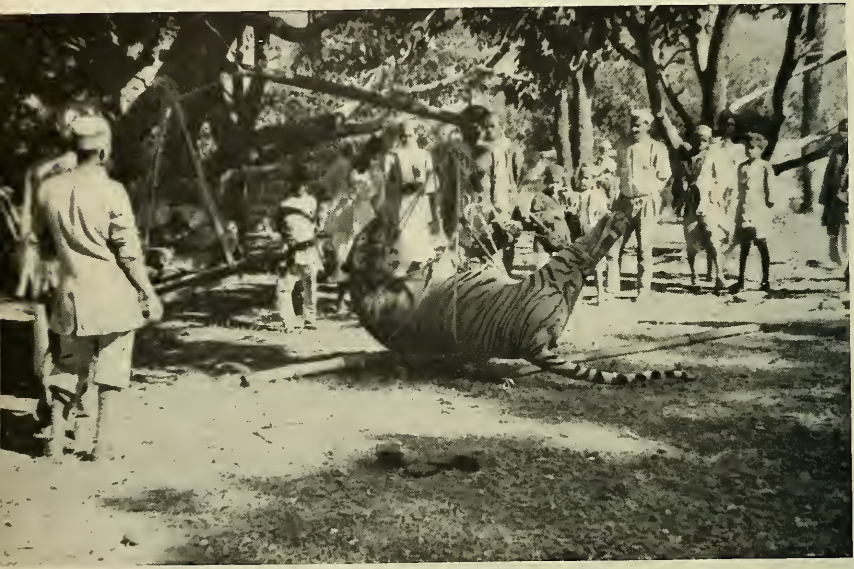
The cutting of timber in this region is under close supervision of the Government Forest officers. The picture at the right shows one of the natives engaged in the work

(Above) The bungalow of one of the forest officers in Kaladhunga, at which the party was staying

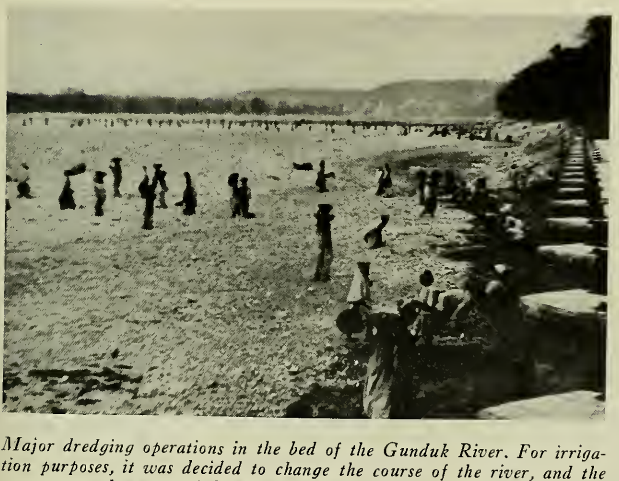
A crocodile shot by Mrs. Davison on the Gunduk River, while operating from the camp of the British Minister in the Nepal Terai on the Gunduk River



Weighing a very large tiger shot by Mrs. Davison. The Department of Mammalogy at the Museum is most anxious to have accurate weights of tigers, very few having been recorded. The means of weighing this one were rather primitive but accurate, the tiger being slung in a cradle at one end of a beam and balanced on the other by rocks, which were later weighed by a small government lead of known weight. The tiger measured 10 ft. 2 in. over the curves and weighed 525 pounds, allowing for a five pound loss of blood



Transportation on the Gunduk River. Both poles and paddles were used to propel the craft, consisting of two dugout canoes lashed together



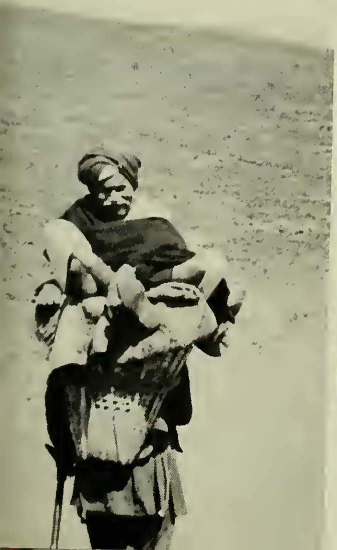
(Above) The outdoor dining room at Colonel Bailey's camp. Left to right: Lt.-Col. Bailey, Lt.-Col. Stevenson, Mr. Davison

Major dredging operations in the bed of the Gunduk River. For irrigation purposes, it was decided to change the course of the river, and the enormous task was carried on entirely by human hands

The high point of the expedition in human interest was a two-day trip across two mountain ranges, which happened to coincide with an enormous Hindu pilgrimage to a series of sacred temples on one of the sacred rivers. Every conceivable type of Hindu was represented, from the highest noble to the lowest diseased beggar, including many old men and women whose ambition it was to die with their feet in the sacred water. One method of travel was to be transported in a dandy on the backs of coolies

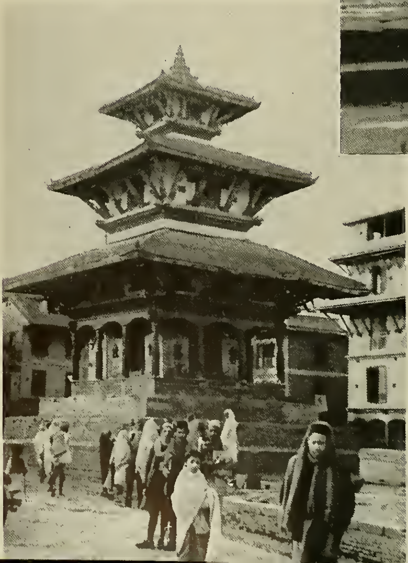
A striking demonstration of religious zeal: masses of Hindus thronging toward a common goal. The pilgrims came from hundreds of miles in every direction and endured severe hardships during their journey

Over the entire journey, the crowds making the pilgrimage were thick, some on foot, occasionally some on native ponies, others being carried on the back of a friend or relative, like the man in the photograph at the bottom of the page



At the end of the pilgrimage, hundreds of steps led up to a famous Buddhist Temple

(Above) A lama from Lhasa, Tibet, who had been making the journey for over a year, the whole distance being covered by crawling on his hands, protected by large wooden gloves, dragging his feet to his hands and repeating the process

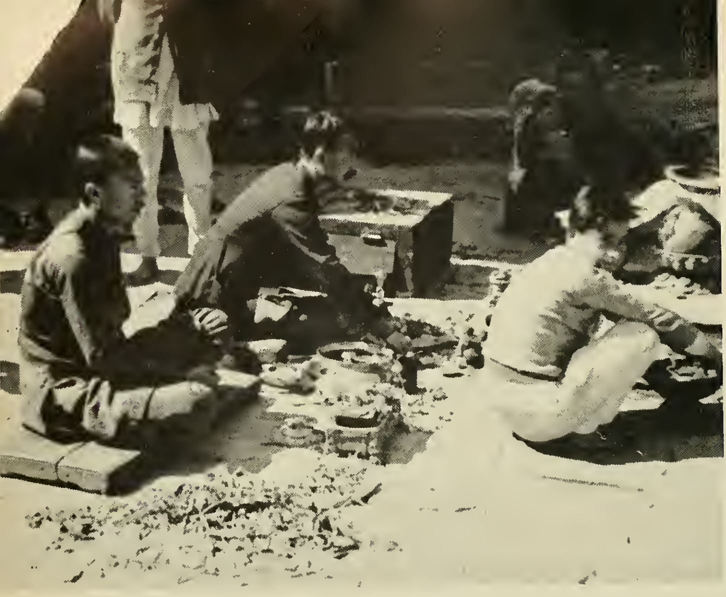


(Left) A Hindu temple

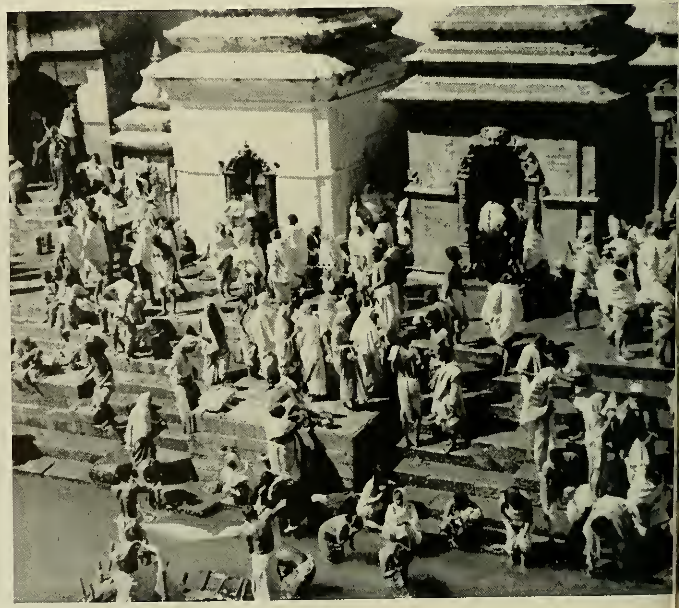
The tower of the temple, showing the eyes of Buddha which forever follow his disciples

(Left) A temple partially destroyed by a recent earthquake

(Below) Buddhist temple



(Above) Pilgrims making puja *(idol worship) within the temple walls. (Below) The actual temples sought by the pilgrims, on the shore of the sacred river*

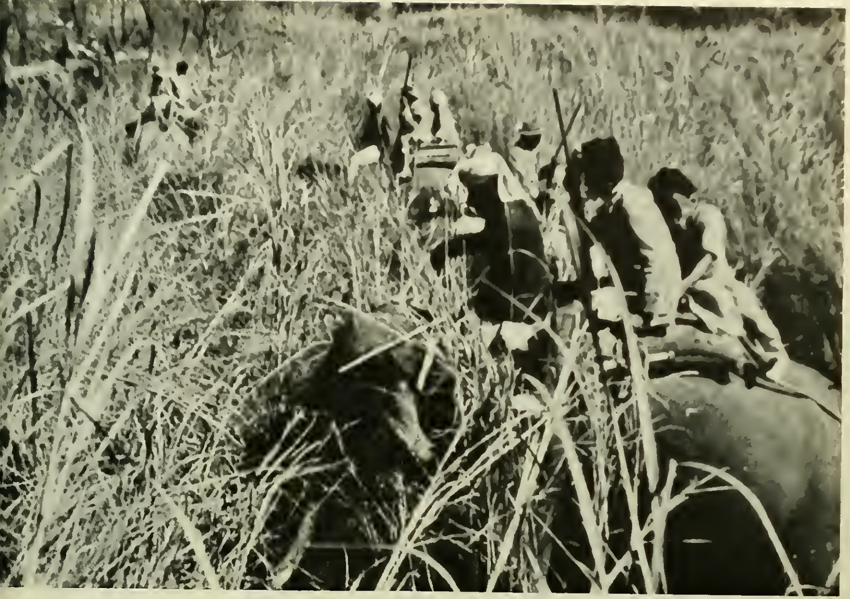


(Above) A typical Hindu Sadhu or priest in a trance

(Below) An automobile being carried over the mountain range on the backs of a hundred coolies

A roadside Hindu shrine in the Nepal Terai

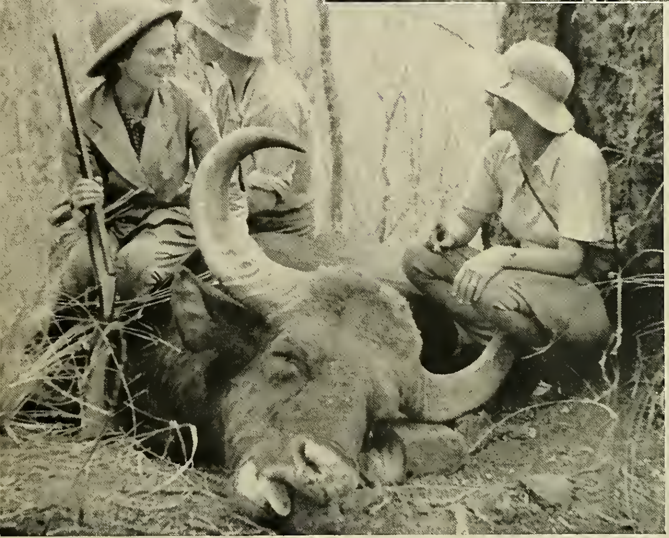
In Mysore, a breakdown in transportation necessitates the use of oxen



Tiger hunting in the Nepal Terai is permitted only by the Maharajah; and when his season is finished, the British Minister is invited to shoot, with guests approved by the Maharajah. The tiger, when located, is surrounded with a ring of elephants, and then driven out of the jungle circle by natives on the back of a big bull elephant. The shooting, while not dangerous, is difficult. The tiger is almost always charging and is only visible for a few seconds, and the elephants are generally stampeding. The picture above shows the ring being formed

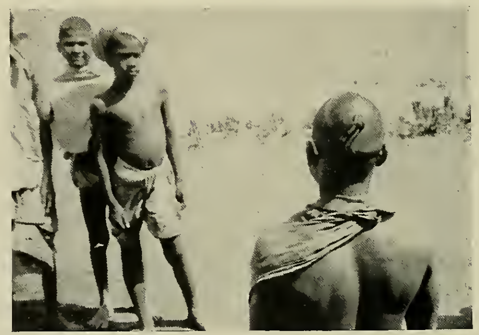
At left, the ringing elephants are crossing the river; below, they are resting and cooling off

The party enters the range of the gaur, a large dark-colored wild ox, otherwise known as the saladang. A scene typical of Mysore and Madras



(Left) A very large gaur obtained by Mrs. Davison for the Museum

(Below) A native with his head entirely shaved except for a few strands by which he hopes to be pulled up into heaven



Two native women in perda, *whose faces and eyes must never be seen except by their own husband*

(Below) An old Model-T Ford occupied by another lady in perda

(Above) Entrance to the Maharajah's Palace in Mysore, a very modern and beautiful city

The walled town of Koweit, in Arabia

An Arabian village built in swampland: a photograph taken on the return flight

Cutting the Jonker Diamond

A rare event in diamond history—upon a light tap of the cleaver's mallet hung the destiny of the largest and finest uncut diamond in the world

By LAZARE KAPLAN

WHEN I was offered the opportunity of cutting the largest uncut diamond in the world, one might suppose that I would reach for it with eagerness. But since boyhood I had spent my life as an independent diamond merchant and craftsman, and I was loath to relinquish that independence and make my every professional movement answerable to another. The time element, too, had to be considered. Could I afford to devote my unflagging attention to another's interest? Would I be neglecting my own business?

Risks

There are as many facets to the diamond business as there are to the stones themselves. To be sure, there was a personal consideration that influenced me. I wanted my son, Leo, to share the experience of cutting and finishing the second largest diamond in the world. But to understand thoroughly my mixed feelings about the proposed undertaking, you should know the risks involved.

It is a common saying that Lloyd's will insure anything. But, while there were no difficulties in insuring the gem against the risks of an ocean crossing, they would not insure the cutting of the Jonker Diamond. The St. Paul Fire and Marine Insurance Company, which underwrote a $1,000,000 policy, were content to have the diamond travel by ordinary registered mail, just as you might send your watch back to the factory to be repaired. But we could not insure the cutting. It is the only case to my knowledge where Lloyd's refused to insure something. Their refusal is indicative of the dangers.

The great moment in the life of a large diamond, therefore, is the instant when the cleaver's hammer strikes the wedge. In diamond cleaving there is no middle ground. It is either done perfectly or the diamond is ruined. Diamonds have grain like wood but offer far more complex problems, and to misjudge the grain is disastrous. In the case of the Jonker Diamond, beyond the usual anxiety that would surround a stone of such unprecedented quality, I was in the difficult position of disagreeing with the unanimous opinion of the European experts on how the diamond could be cleaved.

The damage which a small error in cleaving would do was beyond reckoning, for the peerless quality and extraordinary size of this stone made it the most important diamond extant. I had to think also of the prestige of the American diamond cutting profession, as well as my own reputation, for it was by all odds the largest stone that had ever come to this country for cutting.

Glamour

From the earliest times diamonds have stirred the imagination of men and women the world over. Wars have been fought over them, and wars have been left unfought because of their influence. Kings and emperors have worn them to accentuate their own power, and scientists have studied them in an attempt to fathom their mystery. Pliny, in his Natural History, described them as "the most costly of human possessions." The Greeks admired them because of their resistance to fire, because they were *unconquerable,* and so gave them the name *Adamas.* So elusive are they that strange stories have been circulated about them. Some believed that, though both hammer and anvil would be shattered in any attempt to crush them, if they were "macerated in the fresh blood of a he-goat" they might "with some difficulty be split by a hammer." Others believed that the magnet lost its power when in contact with a diamond, that the diamond "also destroys the effect of poisons, and cures insanity."

The glamour of diamonds was born in my blood. At an age when other children were playing with toys, I was learning about diamonds from my father and uncle in Antwerp, the famous gem center. At 22 I was at the head of an important cutting plant there. Diamonds have always held for me the thrill of adventure.

Nearly half a pound

Those of you who may have seen the Jonker Diamond when it was on exhibition at the American Museum of Natural History (the only occasion on which the public were given an opportunity to view it), remember an irregular frosted crystal about 2¾ inches long and 1½ inches wide. Its weight was 726 carats or nearly half a pound Troy. In the rough the Jonker has all the characteristics of a typical river diamond: the little spots of iron oxide and sand, often forced into the open cracks of the stone by the action of the water; the frosted gray coat; the form and composition; and finally the soft blue fire. This diamond, unlike other large ones, had not a single internal flaw, only a few "skin" flaws.

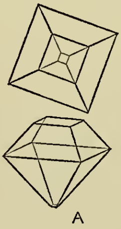
The story of its discovery was like a tale out of a book. Jacobus Jonker was an overworked prospector and farmer of 62, who had persevered for 18 years, always on the brink of fortune, but always poor. He had reached the depths of despondency over his future, when his luck turned. There had been a heavy rain storm and when it died down a native was put to work on bucket gravel, some of which had been washed up by the storm. He found a dirt-crusted stone about the size of a hen's egg. When he rubbed it clean his eyes nearly popped out of their sockets. He had found World Diamond Number One. That night the treasure was put in a stocking and tied around Mrs. Jonker's neck. She went to bed but did not sleep, and the men kept guard at the door of the poor hut with loaded revolvers.

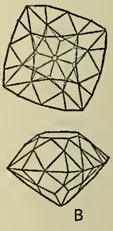
Jonker sold the rough gem to the Diamond Syndicate for a reputed $350,000. It went to London and was of course examined by the leading experts. Even before the diamond reached London the well-known American gem dealer, Mr. Harry Winston, cabled for an option and himself reached London soon after the diamond. He spent a month studying the stone comparing it with the Cullinan, the Kohinoor, and the other famous gems. Upon purchasing it he was confronted with the question of who should cut it. The foreign experts presented their plans with models of the separate gems which they thought could be taken from it.

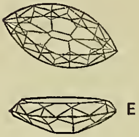
The finding of the correct plane of cleavage presented an intricate problem. Usually, in cleaving a diamond, the planes of cleavage are obvious at first sight, the real problem being to discover the exact position of any chance imperfection. In the Jonker, however, the problem was the reverse, the location of the grain presenting the greater perplexity.

Much publicity had been given to the large flat surface of the Jonker Diamond, and all the European cutters took it for granted that

SOME TYPES OF CUTTING







A. The earliest form of diamond cutting

B. The Brazilian cut brilliant or Old Mine cut, in vogue during the last century

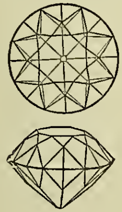
C. The American cut brilliant

this large surface represented one of the planes of cleavage, and outlined the cutting of the diamond in accordance with this theory. But in all ways this gem is a freak of Nature and to follow their plan would have ruined the stone.

Mr. Winston had, a short while before, entrusted me with the cutting of the Pohl Diamond. This was an extremely imperfect gem of 286 carats in the rough, full of flaws. I contrived to cut it into 15 stones, all of which were perfect except one and even that one sold for $50,000. This achievement in cutting was one reason why Mr. Winston thought of me in connection with the Jonker Diamond. He knew further that I had trained a corps of craftsmen whose skill is not surpassed anywhere in the world.

At no time in my experience had I been confronted with such a tremendous challenge as when Harry Winston submitted the Jonker Diamond to me. Everything about this astounding stone was extraordinary. It would seem that Nature herself had entered into the conspiracy to guard this priceless treasure from the covetous possession of man. First she drew a film over the stone's brilliance disguising its surface with a common frosted glass exterior. Again, its very size was disarming. David, when he faced Goliath, might have picked it up and thrown it away in disgust as being too large to fit his sling. Another clever device was for Nature to leave it, not where other diamonds lay, but in the chance backyard of a humble farmer.

Courtesy of Herbert P. Whitlock
Abridged from "The Story of the Gems"



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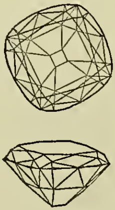

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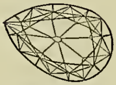
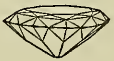
D. The square brilliant, of which the Cullinan IV is an example

E. Marquise cut diamond



F. The pendant cut, of which the No. III Cullinan diamond is an example



F

A disastrous error averted

I studied the diamond for months. A small ledge on the diamond was what opened my eyes to the mistake that the European experts had all made. It took strong self-assurance to follow my conviction. So elusive was this beauty that it was a year before I was sure of its grain. Once I was almost on the verge of delivering the blow with the mallet when I noticed a microscopic bend in a slight surface crack or gletz. This threw all my calculations off at the crucial moment. There was one certain spot on the surface of the Jonker that indicated the correct plans for cleaving. Then somewhat as a naturalist reconstructs a dinosaur from a few scattered bones, I laboriously reconstructed the crystallization of the diamond and thus determined exactly all the planes along which to cleave. Finally when I was sure, to the fraction of a millimeter, I knew that the elusive mystery of the Jonker Diamond lay at the mercy of a light tap of the mallet.

Of all the great diamonds in the history of the world, the Jonker is only the second to be cleaved, the first being the Cullinan. And one who has not seen this operation, which combines the difficulties of an engineering feat with those of a delicate surgical operation, cannot appreciate the strain to which it subjects the operator. When Joseph Asscher cleaved the Cullinan Diamond he so feared that a mistake might be too great a shock to his weak heart and cause him to drop dead, that he had a doctor and two nurses in attendance ready to revive him. When he delivered the stroke successfully he sank into a chair with a gasp of relief, was treated by the doctor, and spent three months in a hospital suffering from a nervous breakdown.

No ordinary instruments would accommodate the great Jonker for this operation and I constructed special ones. I found only one small place where I could make a groove. One tiny slip would spoil the groove and compel me to abandon my whole plan for cleaving. You may well imagine that in this initial step, my son, Leo, and I exercised the greatest care. The groove was scratched deeper and deeper, with a series of sharper and sharper diamond edges, so as to produce a clean V-shaped groove. Then a steel blade was inserted which is not unlike a carving knife except that its edge instead of being sharp is square. This gives the maximum spreading force of a wedge. A specially constructed, counterbalanced mallet was held above it, and my son and I knew that the light tap that would be given in the next second would ring down the curtain on complete failure or complete success. The blow was struck and the diamond fell apart in my hand exactly as we had planned.

I must admit that it was a glorious feeling of superiority that came over me when I had found that I could make this magnificent jewel, of the hardest and most endurable material on earth, obey my command.

Invisible saw teeth

Cleaving is only the first operation in the cutting up of a large stone. While it can be accomplished only in the direction of the grain, the second operation of sawing can be accomplished only across the grain. Whereas the first cleavage took a fraction of a second, the first single sawing required five weeks of continuous work.

The saw is a disc of phosphor bronze about four inches in diameter and between .005 and .002 of an inch thick. None of the standard diamond sawing machines was large enough to accommodate the Jonker, and we had to rebuild one. The edge of the saw is not sharp, but is cut square and is covered with a mixture of diamond dust and olive oil. The diamond dust works into the phosphor bronze and acts as the cutting surface. On a damp day the cutting effect is greatly reduced and at times becomes negligible, and the operator then uses an ordinary electric heater to reduce the atmospheric humidity. When the weather is cold and dry and the windows have to be kept shut, the diamond dust gets into the air and is bad for the health of the operator. At the end of the day he will feel heavy and his cheeks will burn. To avoid this he periodically removes the excess dust from the blade with a tiny mop of cloth. Though the diamond is one of the clearest of known substances, the dust which comes from sawing it is black like lead-pencil powder.

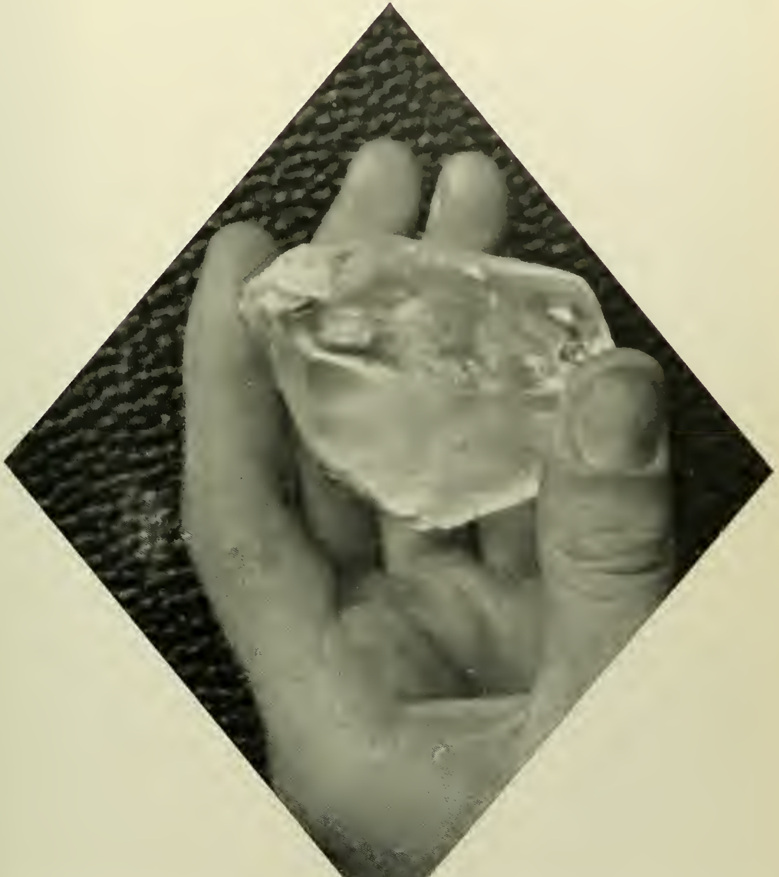
After being sawed the separate pieces are cut and polished. For this they are set in a metal foundation and held against the surface of a revolving disc. This operation puts the facets on the gem. Great accuracy in faceting the diamond is all-important to its beauty. The facets should be arranged so that as much as possible of the light entering the stone is reflected through the top. This mirror-like function of the facets is due to the high index of refraction of the diamond, and it is only with masterly polishing that optimum brilliancy is obtained. The same composition of olive oil and diamond dust does the work. But the wheels, of porous steel, are manufactured especially by a secret process that has been passed down for generations in one family in Belgium.

The destiny of the Jonker

The Jonker Diamond will make 12 separate gems, the largest of which will be approximately 170 carats. Of the original 726 carats the final aggregate will total only a little over 400, approximately 300 carats having gone into dust.

One might think it a mistake to break up a stone of such unprecedented quality; but it will be far more valuable in separate pieces than in one. In former times there was a market for single stones of great size among kings, queens, and princes, but the day of crown jewels has virtually passed. What will be the future story of the Jonker Diamond no one can say. We can only hope that its career will not be attended by the bloodshed and sorrow that has surrounded so many great jewels, and that it will enhance the beauty of beautiful women for many centuries. So far, its discovery has brought happiness to many, and it has brought no sadness into the world. To have taken some part in its story gives a feeling of participation in a great adventure. Humbly I am glad that my adventure with the Jonker has been the means of adding something to the general knowledge about diamonds.

Cutting the Jonker Diamond



An unusual series of photographs published for the first time in NATURAL HISTORY

When a humble diamond prospector discovered the Jonker Diamond he held in his hand:

The largest uncut diamond in the world

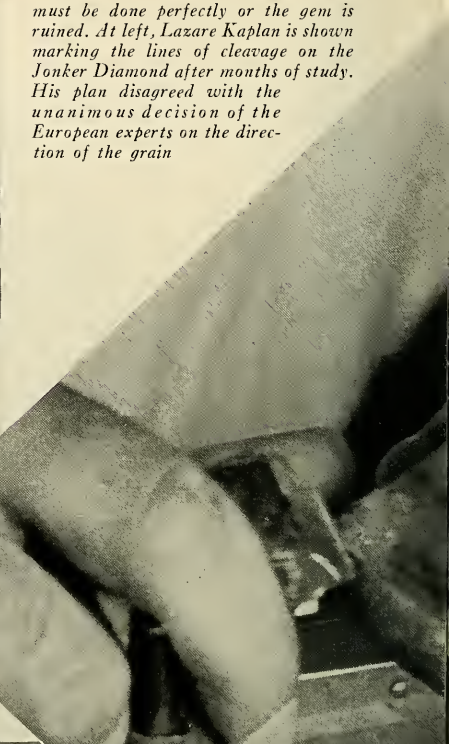
A flawless stone, finer in quality than any of the larger ones in existence

A diamond approximately as large as a hen's egg and weighing nearly half a pound.

An unimpressive lump of crystal with a common frosted glass exterior, a stone which "David, when he faced Goliath, might have thrown away as too large to fit his sling"

Because of the grain, diamond cleaving must be done perfectly or the gem is ruined. At left, Lazare Kaplan is shown marking the lines of cleavage on the Jonker Diamond after months of study. His plan disagreed with the unanimous decision of the European experts on the direction of the grain

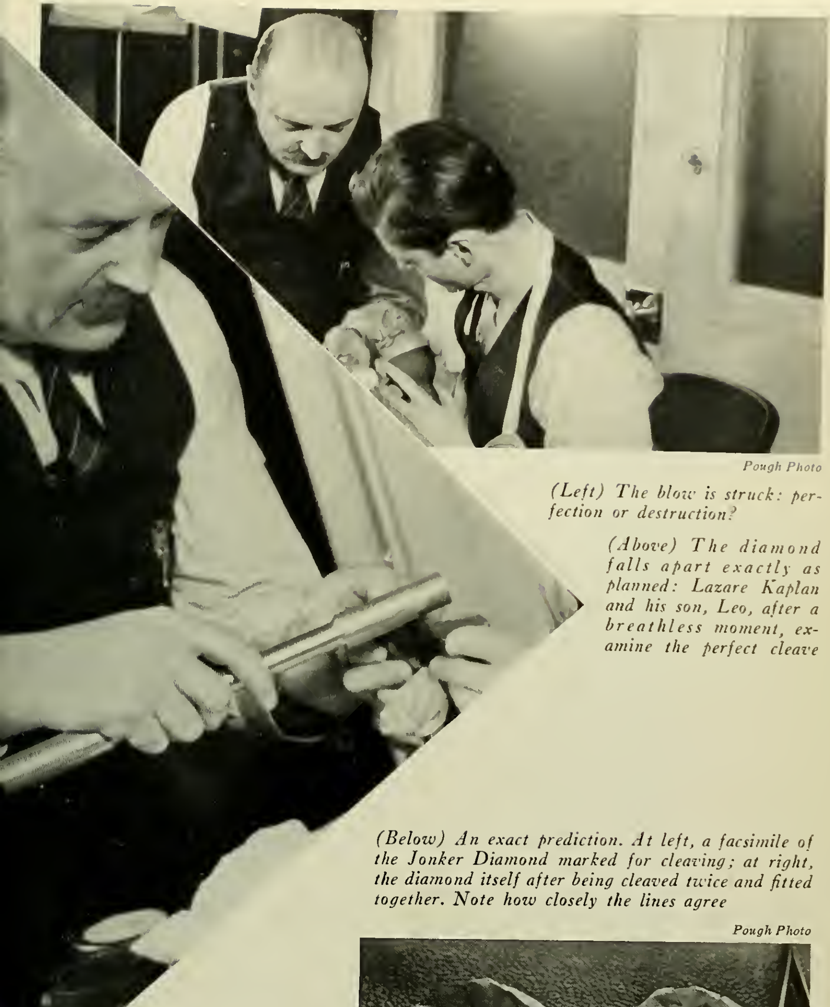
Pough Photos



(Right) A knifelike piece of another diamond cuts a groove for the insertion of a wedge at the point where the diamond is to be cleaved

(Below) The blunt wedge is inserted in the groove

Pough Photo



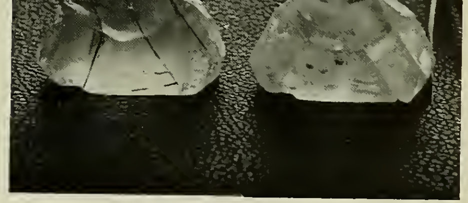
Pough Photo

(Left) The blow is struck: perfection or destruction?

(Above) The diamond falls apart exactly as planned: Lazare Kaplan and his son, Leo, after a breathless moment, examine the perfect cleave

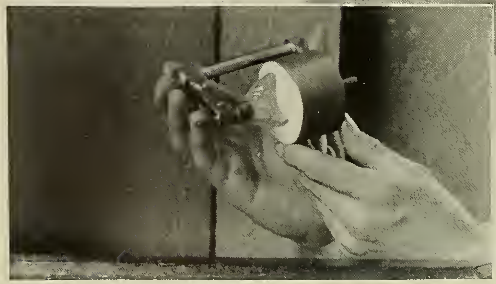
(Below) An exact prediction. At left, a facsimile of the Jonker Diamond marked for cleaving; at right, the diamond itself after being cleaved twice and fitted together. Note how closely the lines agree

Pough Photo



After cleaving comes sawing. Unlike cleaving, sawing has to be done across *the grain*

Below, the operator is shown applying diamond dust and olive oil to the edge of the phosphor bronze disk which serves as the blade



(Left) A special clamp to hold the great diamond during sawing. No ordinary clamp was large enough

(Right) If the diamond dust is breathed in the air it produces a feeling of heaviness and causes the cheeks to burn. Therefore the operator removes the excess dust from the wheel with a small mop of cloth, as shown in the photograph at the right

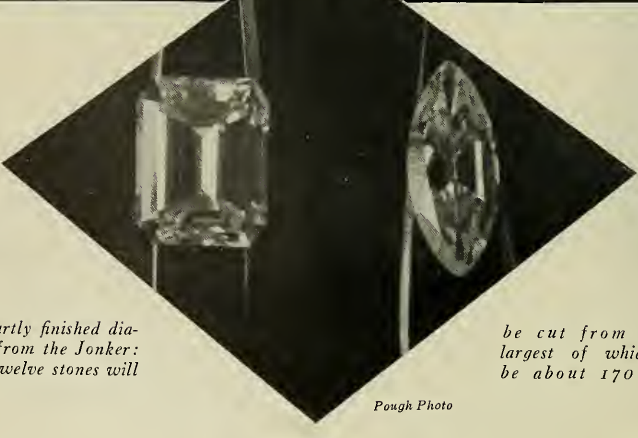
Pough Photo

(Above) An unusual sawing. The blade is slowly working its way up toward a saw-cut previously made from the right-hand edge. The saw blade does not do the sawing; it is the diamond dust imbedded in its blunt edge

On damp days the sawing goes very slowly. Unlike the cleaving operation, which is over in a fraction of a second, the first single sawing on the Jonker required five weeks of continuous work

The final step: grinding and polishing. The diamond is frequently examined under a lens and measured with small gauges to see that its facets are set at the right angle. The facets are placed so as to reflect the light back and forth and enhance the brilliance of the gem

The diamond is ground on a high-speed wheel coated with diamond dust and olive oil (see center photograph). These wheels, of porous steel, are made exclusively by one family in Belgium, in which the secret has been passed down from generation to generation



Two partly finished diamonds from the Jonker: in all, twelve stones will be cut from it, the largest of which will be about 170 carats

Pough Photo

Fun with Sharks

When an indefatigable sportsman girds himself for battle with the most hated creatures of the sea there is excitement a plenty

By COLONEL HUGH D. WISE
U. S. Army, Retired

I HAD had great fun in Cuba, in Hawaii and in the Philippines with sharks, so when I came home to Virginia, in the early nineteen hundreds, I persisted in the sport of my boyhood there and usually kept most of the boats at my father's place, at Cape Charles, smeared with evil smelling shark blood. I was still using hand-lines, harpoons and barrels, but had never attempted to catch big sharks on rod and reel.

Sharks on rod and reel!

Throughout my fishing career, I had been pestered by sharks—Dog Sharks, Bonnetheads, Hammerheads, Mackerel Sharks, Sand Sharks, and Duskies. Little sharks and big sharks had snapped my lines, kinked my rods and slashed fine fish which I was bringing up; but never, until one day at the Virginia Capes, had I realized what sport there might be in catching these pests on ethical tackle. "Sharks! Sport-fish on rod and reel! You're crazy!" would have been my reaction to such an idea.

That day, I had a fine forty-pound drum-fish right up for the gaff when a glint of grey in a swirl of foam flashed at the boatside and when it disappeared so did half of my drum.

"George," said I to the boatman, "If these darned things are after a game, let's play with 'em." Making a leader of a handy piece of bale wire and putting on a big hook, I baited it with the half drum left me and tossed out.

Immediately the bait was seized and the reel shrieked. Novice though I then was in shark taxonomy, I recognized the sharp snout, robust streamline body and keel-like side ridges of a Mackerel Shark, probably the fastest and gamest of our Atlantic species.

Realizing that my channel-bass tackle was not equal to a fight from an anchored sloop such as this promised to be, and knowing that we could not up-anchor before the fish reached the end of my twelve strand line, I jumped into the dory's bow and George, following me, threw off the painter and seized the oars.

All reel drags were squeezed hard down and I was pressing the thumb-pad except when I had to slip line to spare it more than test strain; yet half of the three hundred yards were out and the line hummed like a telegraph wire before we had the boat under way. "Faster! Faster! Follow him! Follow him!" I urged the sweating George who was then doing his very best, but the reel spindle was already showing in spots when we began to hold our own.

After two miles of this chase, during which I had alternately slipped and recovered line, we began to gain a little on the fish and we were obliquing off to try to get a sideways pull to turn him.

Seventeen circles

We were then out beyond the point where John Smith landed, and we knew no more than he when he set out where we were headed for. With numb hands and aching back I held hard while George set an example for a Henley champion. In another mile, we were almost abreast of the tiring shark who now began to yield to my "pumping" and was turning. A little more and we had him circling the boat, a hundred yards off, so we on an inner circle could keep abreast of him. Around and around, seventeen times, he went, his sharp fin and crescent flukes showing above his white surge, and then off he went in another straightaway rush which took out most of my laboriously recovered line and scorched the thumbpad. Then, suddenly ceasing his rush, he sounded to the bottom and we rowed up directly over him. In spite of hard pumping he could not be budged. He might as well have been the anchor until I chanced to remember an old trick.

Taking a bait "jimmy-crab," I locked his claws to encircle my line and let him slide down. Hardly had his wiggling legs landed on the shark's nose when up came the shark and off he went like a dog with a can to his tail. He was simply wild. Never had I seen such speed in a fish! It was one of the few times I had seen a shark leap clear of the water but up he went, once, twice, three times, like a tarpon, and, by these gyrations, he threw the crab. Then he settled down to more circling on the surface but he never again sounded. The "jimmy-crab" had cured him of that!

No living creature could expend such energy without tiring; so, in two hours, he was thoroughly exhausted. I was tired, too, and George slumped over his oars. Finally, the double line came up, followed by the leader and George led the shark to the gunwale, now only waving his tail but still vicious enough to grind his lance-like teeth on the boat's planking. The gaff struck into the vital gills but, made for a seventy-five pound channel bass, its crook straightened under the weight of this big fish who in his frantic threshing deluged us with bloody spray and sank to be pumped up again. This time we got a slip-knot over his tail and hauled him aboard. A beautiful specimen of Mackerel Shark weighing more than two hundred pounds. What a fish! I have caught many bigger sharks but never a gamer one!

"George," I shouted, "what do you think of it?"

"Well, suh," he replied, mopping his face with a scrub-rag, "I thinks I prefers drumfishin."

The beginning of a new sport

Perhaps the sweat in George's eyes had kept him from seeing the possibilities in the new sport which I had discovered at our very door, and in which we could indulge when tuna and other big fish were not accessible. I saw those possibilities, however, and I began experimenting with tackle and bait, and hunting for the places where sharks were most likely to be found. The hydrographic charts on my father's study walls were no longer used by me for navigation but for locating the tide runs where sharks would be looking for prey.

While I was probably the first to take up the sport of angling for sharks in that vicinity, I was by no means the first shark fisherman in the Chesapeake and we must give the credit for that to John Smith who came there some years ago and who nearly met his death by trying to spear a selachian with his rapier, not ethical tackle, by the way. The place where he got a stingray spike through his thigh is still known as Stingaree Point.

All along our Atlantic Coast, offshore and in bays, there is good shark-fishing and it is surprising how few anglers avail themselves of it. Do they think that it is as uncertain and as expensive as swordfishing or do they say, as I used to say: "Sharks!—You're crazy!"

From Cape Charles northward, a string of low islands (Fisherman's, Smith's, Cobb's, etc.), stretching between the open sea and the mainland, makes a narrow sound—the "River," it is locally called—which opens into the ocean through inlets between the islands.

Ideal fishing ground

The comparatively quiet water of the "River," bordered by wide marshes with deep tide channels, teems with marine life and is, therefore, an ideal feeding ground for small and medium-sized sharks, while larger ones hang around outside the inlets waiting for rejects from seines and traps or for other food to drift out with the ebb tide.

In some degree, therefore, an angler may choose whether, by staying inside, he will have several fights with sharks of from fifty to a hundred and fifty pounds, or whether he will go outside and try for a big fellow which might weigh a thousand.

Inside, the angler will probably find that an ordinary fishing boat and regular light tuna tackle will suffice, but outside, he should be equipped for heavy deep-sea fishing.

His boat, large enough for considerable sea, must be fast enough to follow the rushes of the fish and handy enough to maneuver with them.

The boatman, no less than the angler, must understand the game and from his wheel, in sight of the rodman, he must conform the movements of the boat to those of the fish.

I like the swivel-chair in the cockpit, aft of midships, from which position the fish can be fought always over the side rather than over pitching bow or whirring propeller; and, throughout the struggle, the boat should be kept broadside on to the fish, not only so the line may not foul deck-house, flagstaff and tiller but also because the boat will be in better position to conform to the movements of the fish.

Fisher in harness

The angler should be in a swivel-chair so he may swing to face the fish and unless it is below the gunwale, he should be strapped in because a hundred-pound pull might easily slide him overboard.

On the chair there should be a pivoting rod-seat, for the angler could not hold the rod in his hands and, with a belt-rest, his solar-plexus will get a terrific mauling. He must have also a shoulder harness because neither hands nor arms could withstand the strain of hours of tussle with a big shark. Such a fight may last hours and if the angler does not feel equal to that, he had better stay "inside" and content himself with the smaller sharks.

In my observation the greatest danger of losing the fish comes soon after the strike, before the boat is under way, or near the end of the fight, when he is being brought in for the iron.

The shark may hit the bait with a savage lunge, but except with the White or the Mackerel Shark, there is more likely to be a preliminary tugging. When this comes, slip the line a little, and, when he takes the hook, strike! And strike hard! He has a tough and leathery mouth.

Galvanized by the sting of the hook and infuriated by the check, away he goes in a wild straightaway. You can't stop him, so lie back in your harness, tighten down your drags, and put all safe pressure on the thumbpad! Meantime, you are cussing the boatman to get under way and follow.

The boat takes a course parallel to that of the fish and about fifty yards away from it and you, by vigorous pumping, are trying to turn him and to recover some of the line he took out with his first rush.

After a mile or so, the shark and the boat, the one retarded by the pull of your line, and the other helped by it, may be almost abreast in the race and you may have turned him and started him circling. It is your job now to keep him under constant tension, pulling his head toward the center of the circle of which your line is the radius while the boat follows on a smaller inside circle.

If you have in half of your line, to insure against another rush, there will be no immediate advantage in getting back more of it. On the contrary, it is better to keep the fish circling on a long radius to tire him out while you, lying back in your harness, save your strength for the fight to come.

There will be more rushes and more circling and, sooner or later, the shark will probably sound to the bottom and try to rub out the hook. Whether or not he could do this, he must not be allowed to lie there and rest. Your back may ache, your arms may be numb, your hands may burn, but you must "pump him up."

Sometimes a shark will suddenly cease pulling and will dash full speed toward the boat and past it, faster than you can reel in line. There is not much danger that he will throw the hook, but there is real danger that he may snap the line if he comes sharply to the end of the slack. You must throw off the free-spool lever and take on the strain gradually with the thumb-pad.

The dart is driven home

Toward the end, his rushes become shorter, his circling smaller, and his soundings less mulish. He is tired and so are you! Finally, you get the double line up and then comes the steel cable. The boatman takes it and leads the shark to the boatside; the dart is poised and driven home. The lanyard whirls from the bucket. You drop back in the chair and light your pipe. What remains is the boatman's job!

C. Russell Bull, whom I call Charley, lives when not out in his boat, at Townsend, near the point of Cape Charles, Virginia. He is a fisherman and he would rather fish than eat, which is fortunate; for, having to eat, he makes his pleasure provide for his necessity. He had regarded nets, traps, and lines solely as means of capturing edible and marketable fish until I came along and proselytized him to the shark game and so diverted considerable of his time from more useful employment.

At first he knew as little as I about shark-fishing, which was indeed not much, but he was an apt follower of an enthusiastic leader and together, he at the wheel, and I in the chair, we learned until we became an efficiently working pair of "nuts" and a menace to the asterospondyli, which is a "high hat" name for sharks.

Charley's boat, a twenty-foot navy "barge," is seaworthy, well-engined, reasonably fast and handy, and it immediately caught my eye as just the boat for the sport. Its after third is an open cockpit in which I put my chair, only a few feet from the wheel, to let the angler be within easy communication with the boatman who in turn is within arm's length of the engine controls.

Forward of the cockpit is a little cabin in which are two bunks, a hanging table and cooking paraphernalia. All is simple and neat, but there is no pretense of the yacht. It is just a little fishing boat on which two people can live comfortably and, if necessary, two more can live uncomfortably, in hammocks.

Freedom on the wave

Charley is not only a good fisherman and a competent pilot, but he is also an excellent cook. When we sail we stock up with staples, take plenty of eggs, butter, milk, fruit and vegetables. The waters teem with fish, oysters and soft crabs. On our trips we have no schedule and we are not slaves to the clock. In fact, the clock is of minor concern, for it is the tide which regulates our lives. When it is right for fishing, we fish; when it is not right for fishing, we eat and sleep. Meals are prepared when more important matters do not demand attention. If weather be good, we stay outside; if it be bad we run in for shelter and stay there until it is better.

There is always infinite variety in the sea and in the waters opening upon it—"Age cannot wither nor custom stale her infinite variety"—and, for the man who loves them, there can be no monotony. With good company, good air, good food, good rest, and good sport, knocking around in a boat can be just about an ideal existence.

We are not always after sharks and for a change, or to rest tired muscles, we may turn toward drumfish, bluefish, weakfish, or any other variety that will take our bait. Hence the assortment of rods and tackle which clutters the little cabin.

We usually get plenty of these fish, but on one of our trips we utterly failed, and it was a shark which saved us from being "skunked." Specifically it was a specimen of the Great White Shark. This fish must be credited or discredited with being the true "Man-eater," for it is against him that naturalists have most conclusively sustained the murder charge. Linnaeus even indicted him as being the fish which swallowed Jonah, exonerating the whale as being incapable of taking a man down his gullet, though we now know that certain whales could do this.

We had been fishing for a week and Sunday, my last day, with conditions perfect, found us two hours before sunset with but two fish—a pair of small weakfish.

We were then trolling for drum and had just come into Little Inlet, one of my favorite shark grounds, but it was six weeks too early for sharks and with a ten-ounce rod and No. 12 line, I was prepared for nothing heavier than drum. We were rolling along on the swell, hoping vainly for one of them to strike, when I spied a big fin.

"Shark! Stop the boat!" I shouted, and Charley throttled the engine.

"You don't expect to get him on that outfit, do you?"

But I was already rigging a wire leader and a big hook onto my little line.

"We'll try!"

Whee-w-wee-w!

The tide drifted us back, the bait, one of my little weakfish, trailing along beneath the surface fifty yards astern. When it reached the place where I had seen the fin, there came along the line the characteristic tug of a shark. He had firm hold of the bait but had not taken the hook so I slipped him a few feet of line, and Bang! he took the hook and I struck. "Whee-w-wee-w!" went the reel, and I seemed to be fast to a speed boat. "Follow him!" and I put on all safe drag. The little 4/0 reel seemed to howl with pain and I expected the rod to snap at any moment, for I was giving them more than reasonable strain. The boat finally got up full speed and we were following the fish, but he had out all but ten yards of my line when he ceased to gain on us. Then, with the resistance I could give him, we began to gain, and in the next two miles I recovered half of my three hundred yards of line.

Steering off on a course parallel to that of the fish, in another mile we were abreast of him and I had him yielding and beginning to turn. He circled nicely a few times, but then, changing his mind, he went off into another rush of several miles before I could turn him again. When the circling recommended, the tide was carrying us out rapidly, so we went spiralling towards Spain.

"Are you prepared to serve breakfast on this ship?" I asked Charley. "I see no probability of catching this minnow tonight."

"Not unless you and the fish will give me a chance to cook it," he replied, and the shark, unconcerned about our breakfast, spiralled out further to sea.

Land was almost hull-down when he sounded and lay still, and Charley, taking advantage of this armistice, slipped the harness onto me. Hardly was I thus geared when the shark woke up and went off into another long and furious rush which, however, was his swan song for I "put on the heat" and he grew rapidly weaker. The harness was now giving me relief and I saw to it that the shark got none.

His speed a mystery

Throughout the struggle this shark had puzzled me for he was faster than any species I knew, except the Mackerel Shark, but the fleeting glimpses I had had of a blunt nose and a massive body showed that he was not a "Mackerel." When finally he was brought alongside, his fins and fluke stiff, and his body motionless, Charley struck with the gaff but, stimulated by the pain, the shark wrenched the gaff from Charley's hands and went down for another half hour of struggle. Twice more was this repeated but when he came up the fourth time Charley, leaning over the gunwale, finished him with a butcher knife in the gills.

Now we had our first chance to recognize him. The dark spots on his pectorals, his olive ventrals, his ashy-brown back, white sides, caudal keels and triangular serrate teeth identified him as a small though beautiful specimen of the Great White Shark.

On the boat-side he measured nine feet and two inches over all, and we estimated his weight as well over three hundred pounds. He had cost me a sprung rod and a damaged reel but he was worth it. His vitality had been amazing, but the fool fish had helped to catch himself, for it was his frantic rushes and hysterical circling which exhausted him. For long stretches he was on the surface with spray flying over his bow like that from an aquaplane. Nevertheless, it took two hours and forty-six minutes, from hook to gaff, to subdue him.

Perhaps I should be satisfied that he was a modest edition of this largest and most ferocious species of our North Atlantic, for the Great White Shark is said to attain a maximum length of more than forty feet.

Jersey waters

What was said of the Virginia Coast might almost as well apply to the entire Middle Atlantic Coast, and especially to the coast of New Jersey. There is a string of low islands and narrow sand strips standing off from the mainland as outposts against the onrush of the seas, and these separate from the ocean the almost continuous narrow sound which, in different places, we call by different names.

The water, too, has there the same gently rolling loveliness it has on the Chesapeake. There is a ripple, not a surge, to its movement and shadows from fleecy clouds, wafted by breezes laden with salt-marsh aroma, make myriad green tints on the surface. It is all so peacefully restful that even the gulls seem to dawdle in their flight. But through the inlets one bounds out onto the roaring blue ocean—What has all this to do with shark-fishing? Simply that the angler has his choice, as he had at Cape Charles. He may stay inside for little ones or he may go outside for big ones, but one of the uncertainties which go to make fishing interesting is that he may get the big one where he expected the little one, the little one where he expected the big one, or he may get neither.

It may be remembered that it was a Hammerhead on the Chesapeake which literally towed me into this shark-fishing game, but it is not that alone which is responsible for the thrill I always experience when fast to a Hammerhead. He is a wary suspicious fellow who is hard to outsmart and he has game-fish qualities equalled by few other sharks.

Nature, always with a purpose in what she does, has given this fish his freakish head to be used for making his dives and loops, as ailerons are used on an airplane, and so erratic are his gyrations that once—I hesitate to tell it—a Hammerhead tied a knot in my line. I hasten to explain, however, it was a simple knot, not a bowline.

In contrast to other sharks, most of which have rather small, staring, amber eyes, the eyes of the Hammerhead, located in the outer edges of the vanes of his head, are large, dark, and bovine, but please do not imagine that I am trying to make out a case of gentleness for him for he is, as his blade-like teeth indicate, as savage as other sharks, and as mean a devil as any of them.

Fight with Hammerhead

The finest struggle I ever had with a Hammerhead was one day on a glassy sea ten miles off the New Jersey Coast when we spied a high sharp dorsal fin, "gaff topsail" sailors call it, cutting the surface half a mile astern and following straight in our wake. Slowing down our engine, I let out three hundred yards of line baited with a fair size bluefish. As the bait skittered along on the surface the Hammerhead overtook it, circled it and came on. There was really no disappointment in this because it was exactly what a man, familiar with this wary fish, would expect. We opened throttle, dragged the bait past the fin, and this time the shark dashed at it, splashed around it, showed great interest, but was still too timid to strike, so we slowed down, and then—Bang! He had it! On he came straight for us while I wound frantically. Fifty yards astern he seemed to associate us with his toothache; increasing speed, he swung wide around us, and I wound hard to take up the great bellying sag in the line. With the fish a hundred yards to port, the line came straight. I threw off the free spindle lever, thumbed the pad, screwed down drags, struck hard to set the hook and then—what a performance!

A demon on the line

Straight towards us dashed the fish, whirling and pitching on the surface, barely clearing our bow. Then away he went—two hundred yards to the other side while the boatman, leaving his wheel, clambered atop the deck-house to clear the line. Like a flash the fish turned and was back again, just clearing the stern while John fended the looped line from the propeller with a boat hook and I struggled in vain to take in slack. Again and again this was repeated and then the Hammerhead changed his tactics to short dashes back and forth on the surface, and dives and loops beneath it and once, in spite of our backing and turning, he went across under the boat.

John got a lot of practice with his engine and rudder, my wrist ached from winding and my thumb burned from the hot pad before we finally got the fish to circling. After an hour of that, the big gaff hook drove into his gills and the fight was over. It had been like a tarpon-fight except that this demon was bigger and stronger than any tarpon, and he looped in the water instead of going into the air. Hammerheads are wary, fast, and game but I have never seen any fish put up a finer fight than this one did, from hook to gaff. I forgot to measure and weigh this shark so I can give only my estimate—9 feet, 250 pounds.

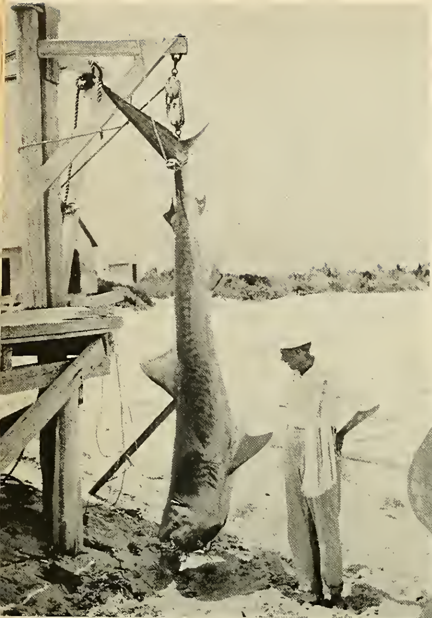
In next month's NATURAL HISTORY *Colonel Wise will tell more of his thrilling experiences —but this time he will deal with the dreaded Tiger Shark in the waters off the Bahamas.*

Fun with Sharks

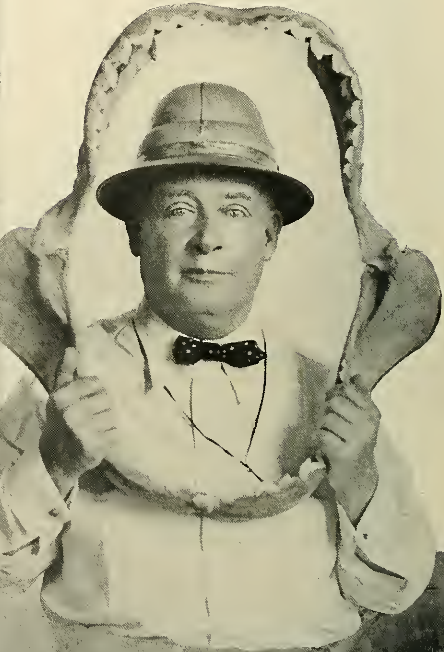
(Below) The Thresher Shark. This excitable fish has a whip-like tail stretching the length of his head and body combined, a weapon with which he herds prey, and destroys nets

(Below) Whale Shark beached at Acapulco, Mexico: One of the largest fish of modern times and one of the most brilliantly colored of the usually drab Shark family. Bright yellow spots are centered in a checkerboard of white and yellowish lines

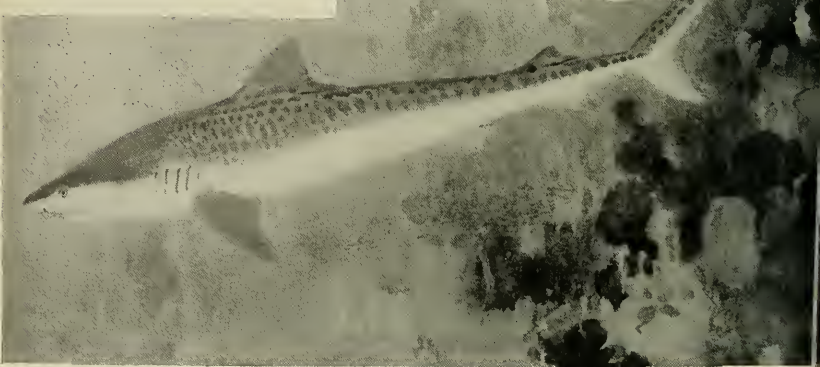
Photo by C. T. Wilson



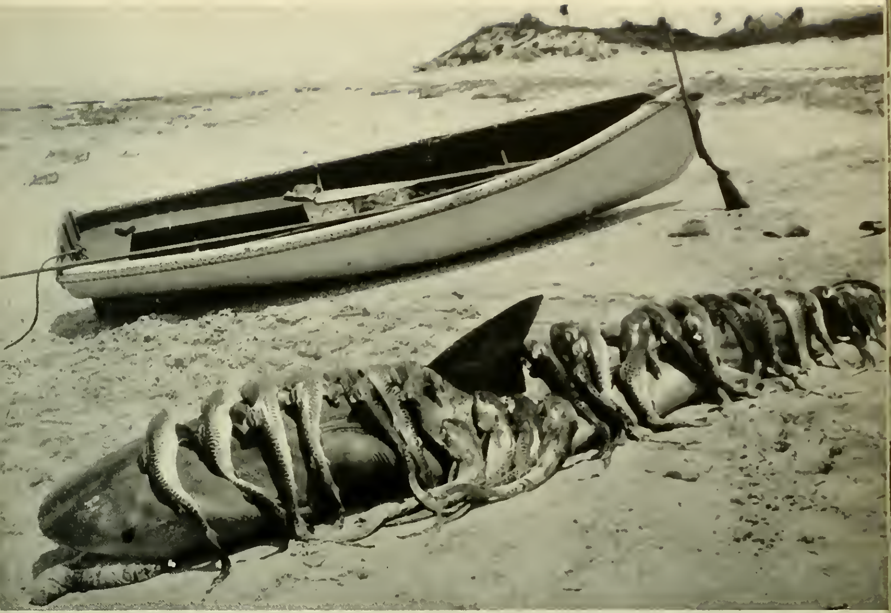
(Left) Tiger Shark. The mention of his name sends cold chills through the natives of the Bahamas and West Indies where he abounds. He averages ten to twelve feet in length and is one of the most savage of his kind



(Right) The Tiger's Jaw: Naturalists have long claimed that a whale could not have swallowed Jonah, and Linnaeus has attributed the deed to a shark. Photo shows author Wise doubling for Jonah



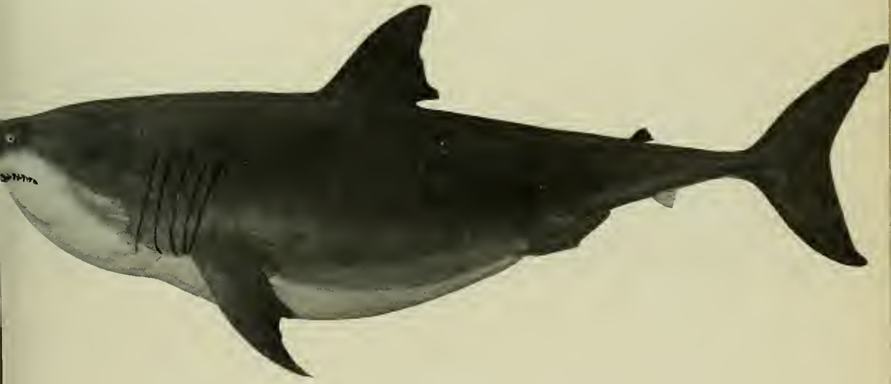
(Below) Gaily colored youth: As the young Tiger Shark grows older, the small dark rings on his skin fuse into a fairly uniform greyish-brown

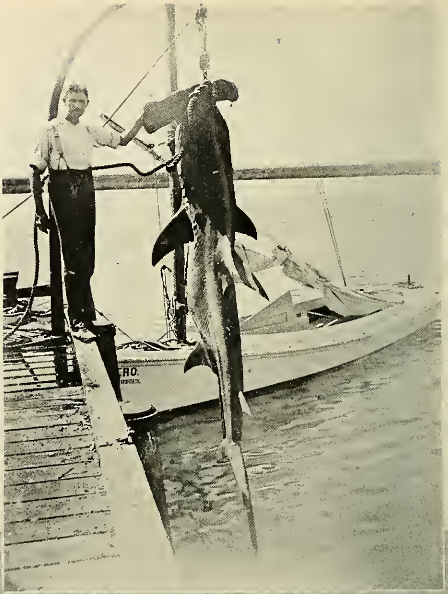


(Courtesy Capt. Lancaster)

(Above) No Mass Suicide here: A Viviparous Tigress, with litter born after her capture. It is fortunate the female is so prolific, for otherwise the cannibalistic tendencies of the older fish would result in racial suicide

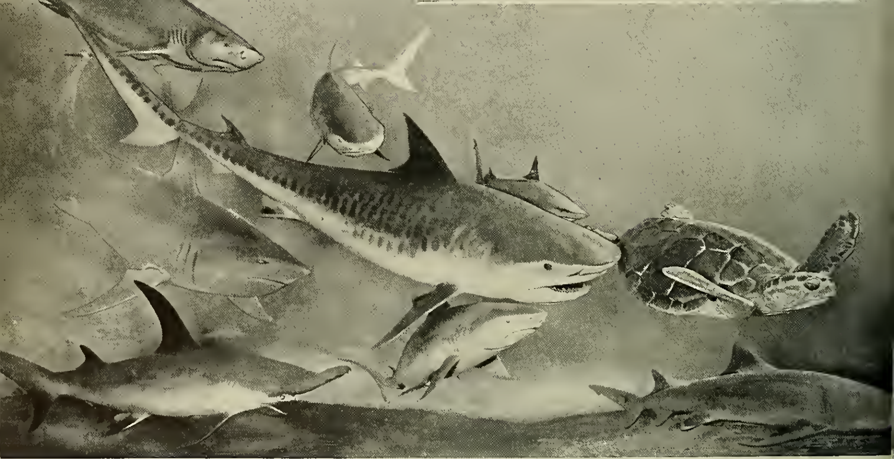
(Below) The True Man-eater: The great White Shark against whom the murder charge has been most conclusively sustained. Essentially a rover, he is possessed of astonishing strength and vitality



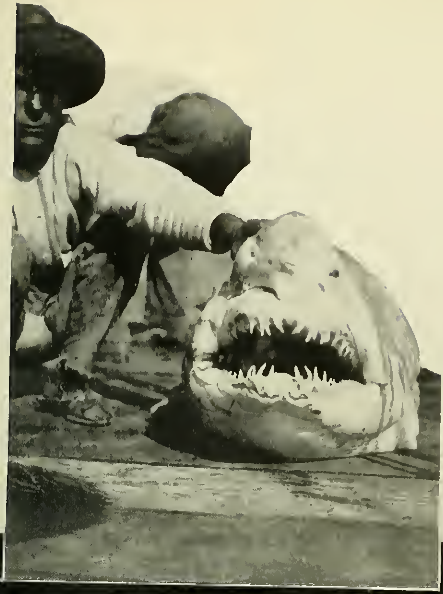


(Right) Twelve and one-half foot Hammerhead with six foot man; Dr. E. W. Gudger holding one end of the freakish "hammer," Nature's equipment for making the tricky dives and loops that have literally tied knots in the fisherman's lines

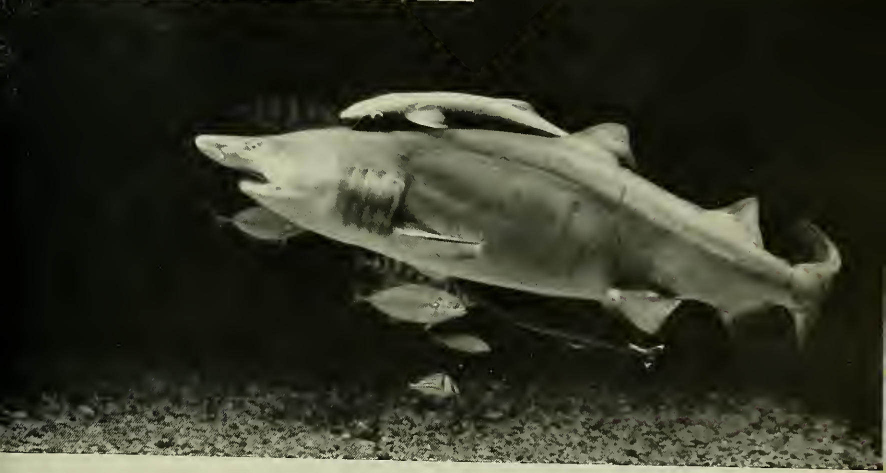
Courtesy E. W. Gudger



(Above) Rovers of the Deep: White Shark, Hammerhead Shark, Southern Ground Shark, Tiger Shark, Spot Fin Ground Shark, Sand Shark, Loggerhead Turtle. The latter is often attacked by sharks, especially the White and Tiger Sharks



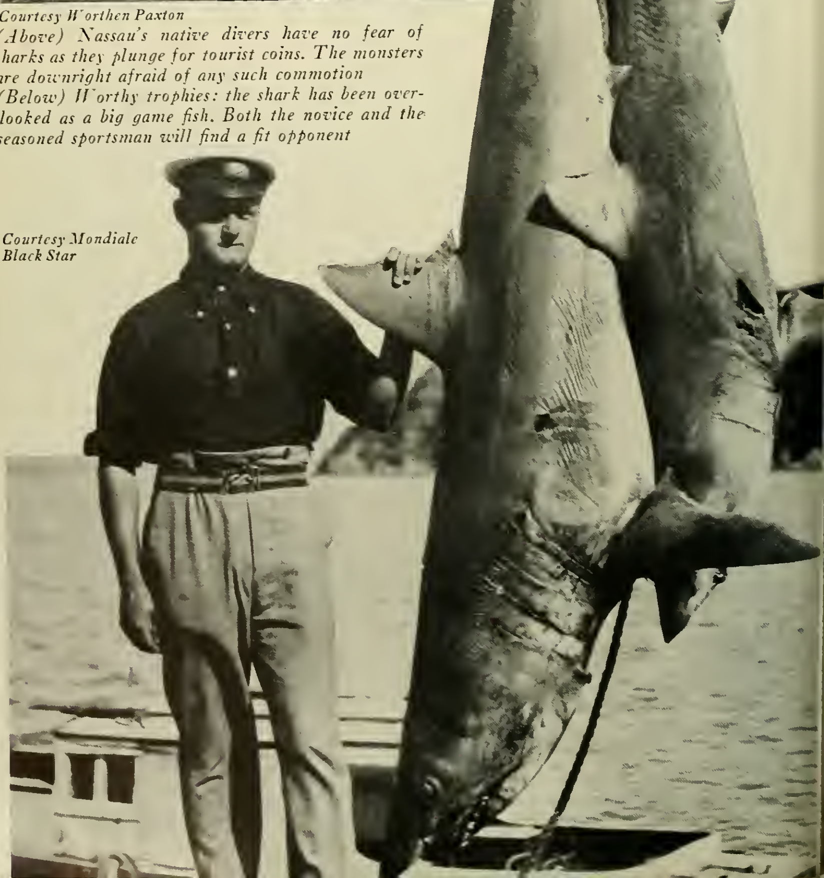
(Left) Hideous: No creature of the sea is so gracefully lithe gliding through the water, but none is so terribly fearsome as he dashes at his prey



(Above) Shark carrying an underseas "Hitch-hiker": The remora, a fish that clings to the shark, snatching crumbs from his table. Fixing himself by a suction organ to the shark's body, he often travels far out in the ocean

Courtesy Worthen Paxton

(Above) Nassau's native divers have no fear of sharks as they plunge for tourist coins. The monsters are downright afraid of any such commotion
(Below) Worthy trophies: the shark has been overlooked as a big game fish. Both the novice and the seasoned sportsman will find a fit opponent



Courtesy Mondiale
Black Star

Worlds Underground

Nature's most sublime handiwork and the art of early man await the tourist who ventures into the earth

By ANNA MCNEIL

WE are all wanderers and explorers at heart, fascinated by the spell of the unknown, yearning to cast our daily routine aside like a garment, and to "take our pack and set out for the ways beyond." When the comforts and pleasures of home give place to the lure of distant scenes and attractions nothing is more enchanting than a cavern tour. Interest never slackens, for no two caverns are alike.

Perils of cave exploration

The men who first entered caverns braved the perils with inadequate light and equipment. A false step spelled injury or death. The sound of their own footsteps was terrifying; the dust stifling; the shadows full of menace. There was the constant fear that fragments of rock might become dislodged and block the exit; and always the possibility of a plunge into an underground stream. Modern inventions have now made all explored areas safe. Electrically operated elevators provide swift and easy descent. Electric lights remove all hazards. Experienced guides conduct sightseers so that one cannot get lost. There are no temperature changes for the thermometers in practically all caverns remain stationary at about 56 degrees F.

Howe Caverns, New York, are visited annually by 100,000 tourists. These caverns, an hour by automobile from the state capital, Albany, are in the fertile and picturesque Schoharie Valley, a short distance from an old stone fort in which the pioneers took refuge from the Indians, and which in a perfect state of preservation is now used to house relics of these early families. The caverns, which geologists claim have been a million years forming, lie in beds of limestone nearly two hundred feet thick. One of the marvels is a winding way, 550 feet in length, the work of erosion, in which the turns are numerous and so abrupt that persons walking single file cannot see the individual directly ahead. There is a delightful boat tour on a limpid lake two hundred feet beneath the earth's surface.

From Howe Caverns the tour leads to the Shenandoah Valley in Virginia, one of earth's loveliest spots. The name is derived from an Indian appellation meaning "Daughter of the Stars." The valley begins at the confluence of the Potomac and Shenandoah rivers at Harpers Ferry and extends between the Blue Ridge and the Allegheny Mountains southward for nearly two hundred miles to the historic James. Its scenery is tranquil and charming. Beneath the floor of this peaceful valley lie the Shenandoah, Massanutten, Grand, Endless and Luray caverns and the famed Blue Grottoes. These have probably all been occupied by prehistoric man; have served as places of refuge during Indian uprisings, and have provided shelter for the soldiers of both armies during the war of 1861-65.

Nature's sculpturing

Some of the notable sights within this group are the Persian Palace, the Ball Room, the Cathedral, the Saracen's Tent, and the Hall of the Giants. There is a wedding scene with a bride in white, a bridegroom and attendants, all cunningly sculptured by natural processes. On the ceilings and along the walls are animals, flowers, trees, and replicas of familiar objects, all so realistic that the skeptical declare that they must be the work of man although they assuredly are not.

Since Calvin Coolidge summered in the Black Hills, the gorgeous scenery of this region has attracted throngs of visitors to the Dakotas. Crystal Cave in South Dakota can be reached by leaving the main highway between Rapid City and Sturgis, near the town of Piedmont, and following a road five miles in length through Elk Creek Canyon. This cave was found by hunters who followed a wounded mountain lion into an opening in the face of a cliff. They emerged into a high-ceilinged room covered with prism-shaped crystals which reflected the colors of the rainbow in the light of their pine torches. More than 1450 rooms in this cave have been opened.

A dome of diamonds

Jewel Cave, sixteen miles from Custer, South Dakota, on Highway No. 36, gives the effect of the whole interior being studded with diamonds. A chamber called the White House has a dome-shaped ceiling, architecturally perfect, covered with glittering crystals.

Missouri has a group of caves which rank with the largest and most interesting. Onondaga Cave, near Leasburg, eighty-five miles southwest of St. Louis, has been opened for three and one-half miles. Part of the tour is made by boat. This is an onyx cave and some of the formations are nowhere surpassed. The Lily Rooms are characterized by water-lily replicas, the lily pads of onyx seemingly afloat in glistening pools. Embedded in the floor of this cave are two human skeletons which in the slow course of the ages have become thickly encrusted with onyx.

Marvel Cave, five miles west of state highway No. 43 and fifteen miles southeast of Reed Springs, Missouri, is in the "Shepherd of the Hills" country. It was the haunt of many animal species during the Pleistocene era, and contains a Dead Animal Chamber in which are the remains of thousands of creatures, some long since extinct. Naturalists assert that this was the chosen mausoleum of wild animals of past ages.

Many volumes have been written describing the miracles in stone of Mammoth Cave, Kentucky, discovered by a bear-hunter in 1809, and the first cavern of importance to be opened to the public.

Mammoth Cave has been explored for 150 miles and probably covers a very large area not yet known. It has become part of the vast National Park system which the United States Government has organized to preserve natural conditions and historic and scientific features unimpaired, for all time. Thousands of acres have already been acquired and the purchase will eventually include Kentucky's entire cave region.

Four tours have been arranged, the longest of which occupies more than eight hours. The crowning glory of the cave is the Star Chamber. The ceiling is heavily coated with a jet black mineral deposit pierced with glittering crystals. The guides carry acetylene lamps. As the rays of light are directed upward, the crystals sparkle brilliantly, and the illusion of the heavens in the pure severity of a winter night is complete.

The ceiling of the Snowball Room is covered with globes of gypsum as if a snowball fight had been waged by elfin sprites.

In the Crystalline Gardens there is a two-mile walk over a path which seems to have been paved with crushed jewels. Almost every flower known is reproduced in virgin white with foliage of curling, acanthus-like gypsum. In contrast to this enchanting sight there is a formation of great length and awesomeness which resembles the bed of an ancient river with five cities, demolished by Time, along its desolate banks.

Mighty voices

Echo River, 360 feet below ground, is a vast resonator. The slightest sound is magnified a thousand times, gathering sweetness as it rolls away through the dim corridors of stone, until lost in unknown depths. Standing at a certain point the listener feels the very earth tremble with the vibrations of his voice.

Radio experts have conducted experiments in Mammoth Cave which prove that radio waves of the frequency used for broadcasting pass readily through 300 feet of solid rock.

Five hours are required to visit the points of interest in Colossal Cavern, near Mammoth Cave. This is the sweets shop of the elves, for there are numerous saccharine incrustations so candy-like in shape that whole cartloads of confections appear to have been spilled there.

A giant lizard motionless on the brink of a stream proves on close inspection to be a bronze-colored mass of flint.

New Entrance Cave has a Frozen Niagara of onyx which is a startling counterpart of the famous cataract and is considered by many persons to be the most beautiful of any cave formation.

Great Onyx Cave is known far and wide for its exquisite gypsum "feathers" and for its Hour-Glass.

The interior of Great Salts Cave is composed of chemically pure Epsom salts. Every movement of a person walking and the heat from the lights being carried, dislodge countless particles which fall like snow.

Journeying westward, Arizona has a Colossal Cave, 26 miles from Tucson in the Rincon Mountains, which has been explored for days by experienced men who have found no end to it. There is a legend, probably well-founded, that early Indian tribes used this cave as a passageway to the San Pedro canyon at the farther side of the Rincon range.

A natural mausoleum

Gypsum Cave near Las Vegas, Nevada, is one of the best-known of the smaller caves from its association of man with extinct animals. It has yielded bones, claws, and even the coarse, yellowish hair of the ground sloth, the bones of the native horse, and two species of American camels, besides quantities of bird and small-animal bones.

Man's occupancy has been found in the form of charcoal, burnt sticks, flint dart-points, and crude wooden dart shafts decorated with painted designs. These have been uncovered in the same deposits as the animal remains, or still lower. The Southwest Museum of Los Angeles is conducting further explorations within the cave in the hope that subsequent discoveries will settle the question whether man inhabited the continent thirty thousand and more years ago, or whether the Pleistocene animals survived until a more recent period than has been assigned to them.

The Carlsbad Caverns in southeastern New Mexico are believed to honeycomb the entire Guadalupe Mountain range. The secret of their existence might never have been revealed had it not been for millions of bats which nightly, rose from a vent in the mountain side, appearing at a distance like smoke from a chimney. This sight attracted the attention of Jim White, a cowboy, who located the spot after a difficult climb and spent three days within the cavern, lighting his way with candles. When he told of the wonders he had seen his friends complimented him on his lively imagination. The story finally reached a government employe who put credence in it and investigated for himself. The deposit of bat guano which had accumulated at the entrance for centuries, sold for hundreds of thousands of dollars.

The Carlsbad caverns have now been made accessible and attract the equivalent of a large city's population, each year. They offer the most massive formations known. One chamber is half a mile long and 349 feet high.

Records of early man

There are many caves throughout the United States that are little known to the public but of importance because of prehistoric finds. An expedition of ten men recently searched Utah's "Bad Lands" for dinosaur remains. In a canyon in the Grand Gulch district they came upon a cave with many undecipherable pictographs upon its walls. A curious design formed in a group of grooves hewn into the rock was disclosed in another cave. A score of ears of corn, a bunch of sticks, a boll of cotton and a boomerang were among other discoveries and were pronounced by museum authorities to be possibly ten thousand years old.

Food cakes resembling the modern doughnut have been found in caves near Kenton, Oklahoma, together with crude domestic implements. The original doughnut makers passed into oblivion centuries ago and not even legend persists to throw light on their identity.

Human remains in a mummified state have been found in Kentucky caverns with meagre evidence of their times and customs. These people lighted the gloomy recesses with fagots bound together with strips of bark, dipped in bear fat. Their utensils were gourds, shown by many broken pieces. Corncobs, watermelon and sunflower seeds, and tobacco believed to be the oldest in existence, have been brought out for study. Fragments of moccasins and of textiles crumbled into dust, however, at the moment of exposure to the outside air.

The world's first miners delved for salt, easily obtained with primitive tools. Rushing underground rivers long since dry, have hollowed out vast caverns in western salt mines and these have yielded stone hammers with wooden handles, a carved club of a type developed thousands of years ago, sandals made of yucca fibre and many human bones.

The lore of Indians, Mexicans and Spaniards is a jumble of romancing against a background of possible fact. Amazing tales are still told of hidden treasure brought in ancient times from Mexico and Peru and guarded by members of an Indian esoteric order who inflict terrible punishment upon white men if by accident or design they locate the caves in which this fabulous wealth is secreted.

A number of cave sites in northeastern Nevada are soon to be excavated under direction of the Bureau of American Ethnology. It is hoped that discoveries will be made which will throw some light on the culture of the mysterious Mound Builders. It is not now known if Aztecs or other tribes from Central and South America actually migrated northward and came in physical contact with the Mound Builders, or if the latter absorbed certain points in common indirectly, possibly from trade with a people in association with the Aztecs.

Cavern explorations on other continents have yielded rich returns. An Italian expedition searching for traces of prehistoric man in southern Africa, reported the finding of an iron foundry buried six feet deep in an enormous cavern, in strata of the Paleolithic age. Iron still is smelted by primitive people with the methods employed four thousand years ago.

Superstitions

In ancient Europe caves were supposed to be the abode of sibyls, nymphs, fairies, dragons and evil spirits. No man dared descend into their depths for fear of what might happen to him when his intrusion was discovered. In the early centuries, the practitioners of black magic asserted that a unicorn's tooth was the most potent of charms. Superstitious man's desire to possess such a talisman outweighed his dread of the unknown. He knew that wild animals had their dens in caves and reasoned that a unicorn's tooth would be found there if anywhere. He ventured within and returned without the charm but with no tale of curse or disaster or encounter with eerie inhabitants. Thus, caves came to be freely explored. Tens of thousands of animal bones, the accumulation of eons, were revealed. In the light of later knowledge these have been classified. The reindeer, grizzly bear, woolly rhinoceros, cave lion, brown bear, bison, cave bear, wolf, mammoth, the great urus, elk, and hyena once roamed the continent in such a remote period that climatic conditions were wholly unlike those of today.

Ancient art galleries

The caverns of France contain rock pictures estimated to have been made many thousands of years ago. Prehistoric man drew them with sharp pieces of flint. The crude outlines are still visible. Since practically all of these drawings represent animals, it is believed that they had some connection with weird rites practiced by cave men to insure success in the hunt.

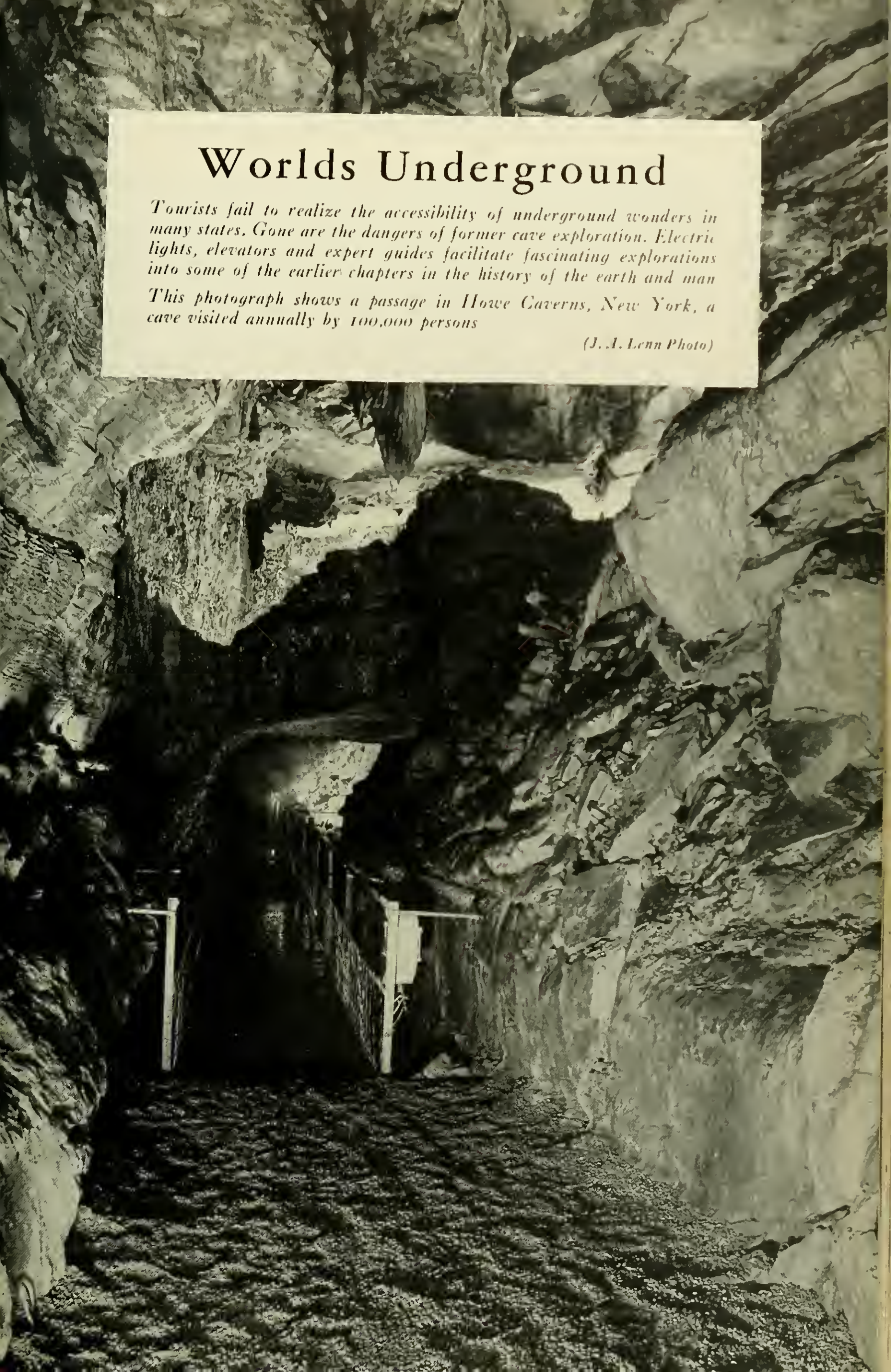
One of the largest of these ancient art galleries was discovered by a small boy who burrowed through a hole in the ground on his father's farm, which attracted him because of its unusual size. He had heard his elders talk about the drawings on cavern walls, and boylike was eager to make such a find for himself. A few feet from the entrance he was able to stand upright and he groped his way through a long corridor untrodden for scores of centuries and finally emerged into a huge chamber. In the dim light he discerned that the walls were literally covered with animal likenesses and with the imprint of men's hands, the work of Cro-Magnon artists.

The boy's experience did more to foster cave exploration in France than anything that had previously occurred.

Cro-Magnon artists flourished in Spain, likewise.

Many hitherto undiscovered caves will probably be revealed to airplane explorers, who, flying low, can detect entrances that are hidden from persons on the ground. This will be especially true of caverns on mountain sides and in canyon walls.

Perhaps our own United States holds in its million-year-old caverns, many secrets of the infancy of the human race. It is certain that the richest and most startling archaeological finds are yet to be made.

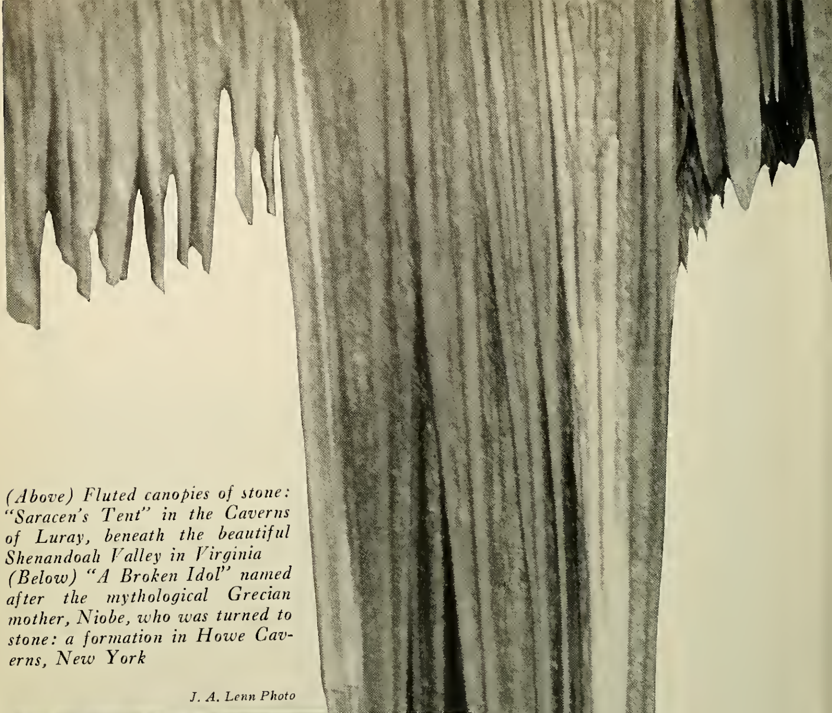


Worlds Underground

Tourists fail to realize the accessibility of underground wonders in many states. Gone are the dangers of former cave exploration. Electric lights, elevators and expert guides facilitate fascinating explorations into some of the earlier chapters in the history of the earth and man

This photograph shows a passage in Howe Caverns, New York, a cave visited annually by 100,000 persons

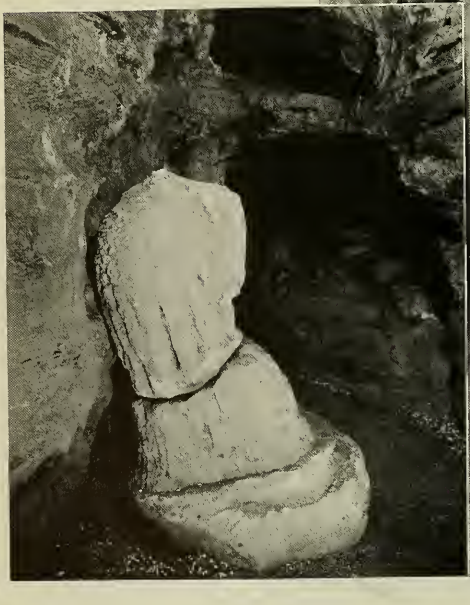
(J. A. Lenn Photo)



(Above) *Fluted canopies of stone: "Saracen's Tent" in the Caverns of Luray, beneath the beautiful Shenandoah Valley in Virginia*

(Below) *"A Broken Idol" named after the mythological Grecian mother, Niobe, who was turned to stone: a formation in Howe Caverns, New York*

J. A. Lenn Photo



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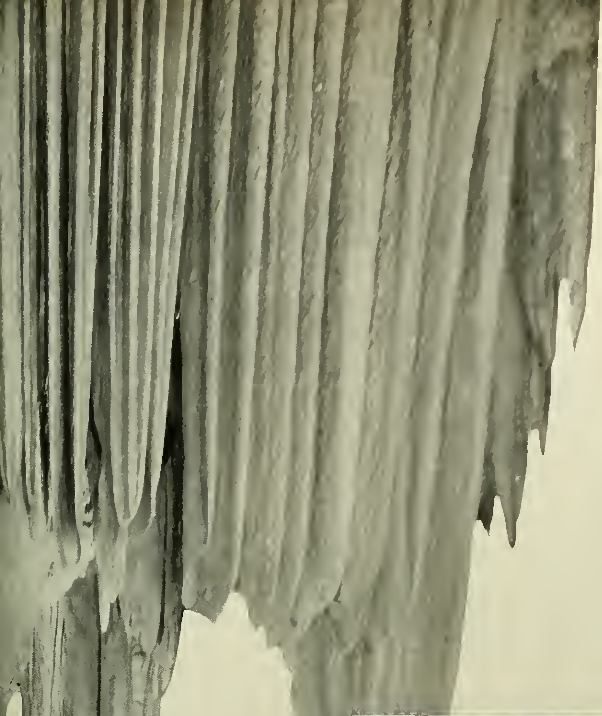
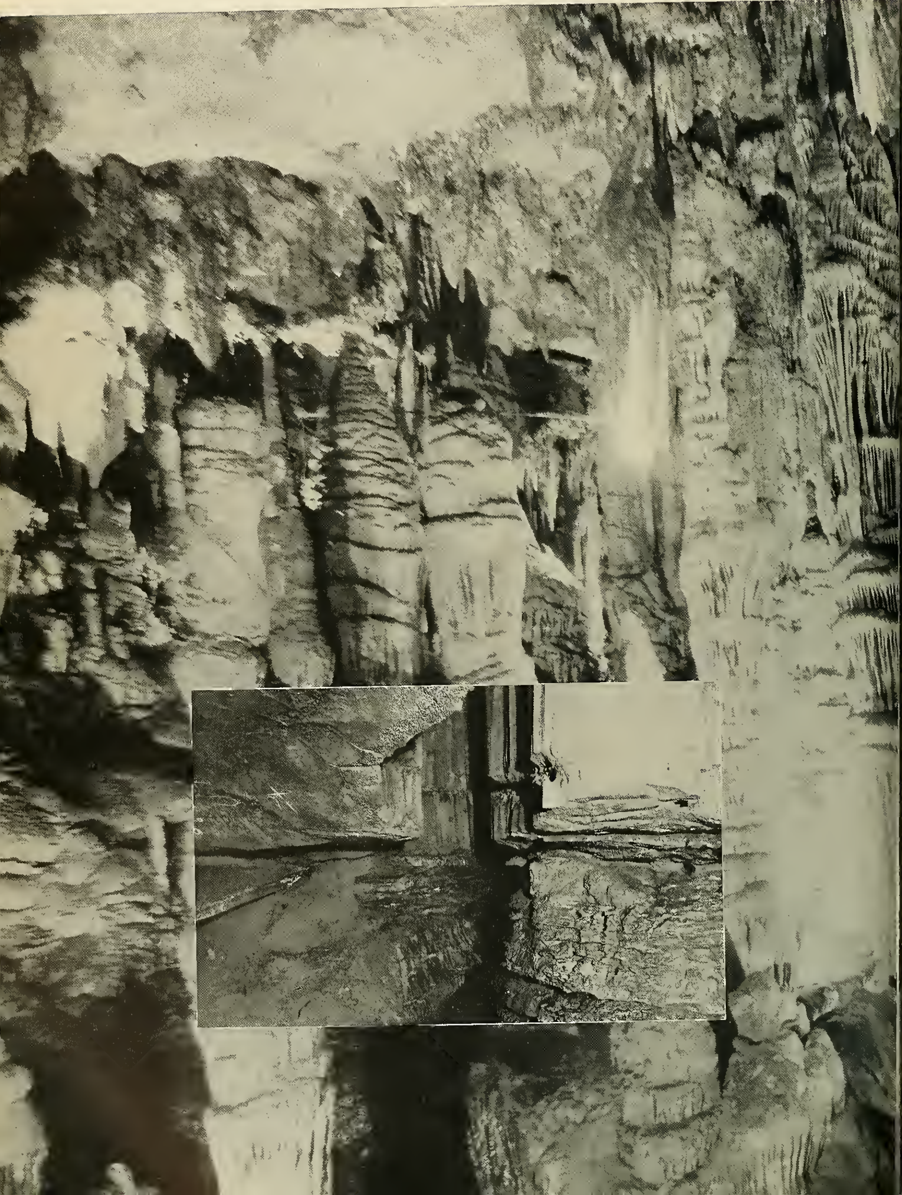


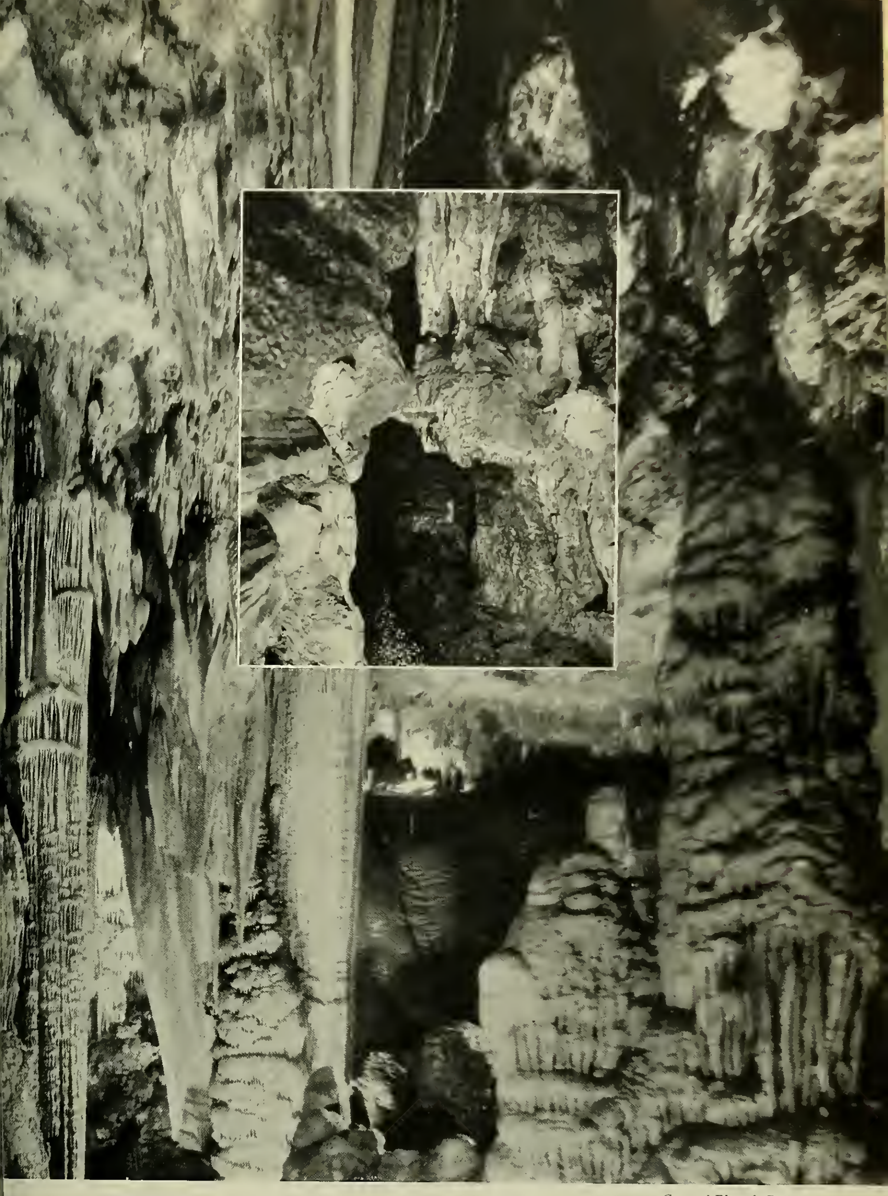
(Right) The Bishop's Pulpit, Howe Caverns, New York: one of many strange examples of Nature's underground handiwork that can be seen within an hour's drive of Albany

(J. A. Lenn Photo)



(Below) A fantastic chaos of pillars and curtains greets the visitor at the entrance to the Giant's Hall in the Caverns of Luray, Virginia (Insert) Side Saddle Pit, Mammoth Cave, Kentucky. Since its discovery in 1809, Mammoth Cave has been explored for 150 miles. The visitor has a choice of four tours, the longest of which requires more than eight hours

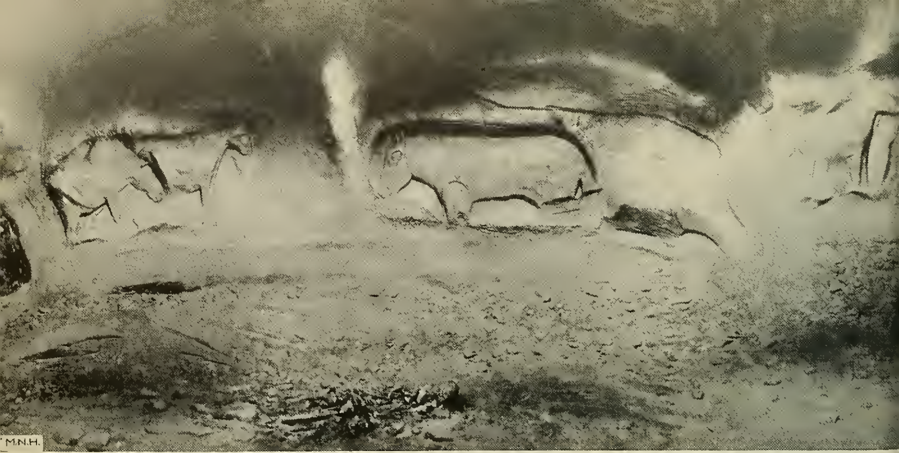
(Photo: Louisville and Nashville R. R. from E. J. Hall)



General Electric Photo

(Insert above) The Kissing Bridge, Howe Caverns. The Winding Way in which this feature occurs, is 550 feet long and twists so abruptly that one cannot see the persons walking immediately in front of him

(J. A. Lenn Photo)

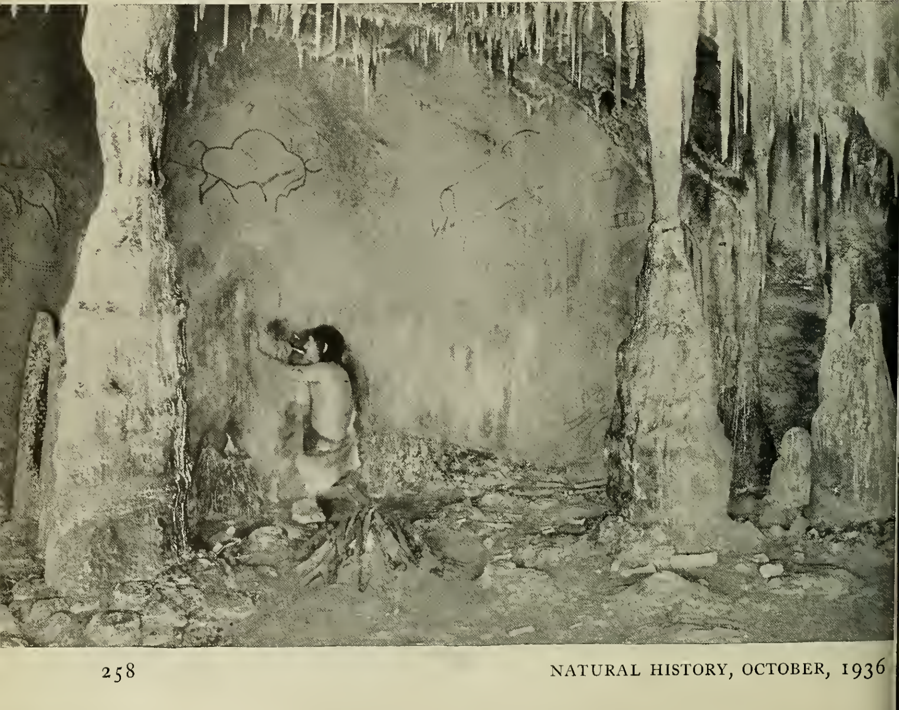


© Field Museum of Natural History

(Above) The famous frieze of horses in the Cap-Blanc rock shelter in southwestern France. Ice Age hunters who carved these figures fought the large cave-bears for the shelter of caves, and produced the finest naturalistic art of prehistoric times

(Below) One of our Cro-Magnon ancestors of about 30,000 years ago engaged in artistic endeavor. In the man's right hand is a hollow bone tube through which he blows powdered red ochre around the outlines of his hand to form an imprint on the wall

Exhibit reproduced by P. Gatier, under the direction of Abbé Breuil. Courtesy of Field Museum of Natural History ©



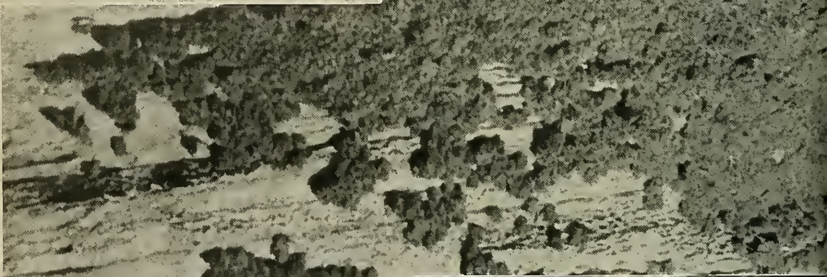
(Below) A Neanderthal Family of perhaps 50,000 years ago represented at the entrance to the Devil's Tower rock-shelter at Gibraltar. Neanderthal man is believed to have been the first to seize a woman and protect her from animals and other men. He lacked tools for sewing clothing, yet he sometimes endured the climatic conditions of the modern Eskimo. Fires glowing at the mouth of his cave barred animals and cold

Courtesy of Field Museum of Natural History ©

(Below) Members of the Cro-Magnon race which drove the more primitive Neanderthal people out of Europe: a painting by Charles R. Knight for the American Museum, showing early artists at work on the famous Procession of Mammoths in the cave of Font-de-Gaume, Dordogne, France. Light was provided by stone lamps burning tallow

Creatures of

Glimpses of animals which have never been seen even by their own kind: a remarkable series of cave portraits by Charles E. Mohr. Born into eternal night, some of the creatures in these pictures may never have seen light until the photographer's flash startled them in their haunts, if indeed they have eyes to see. All are native to eastern United States



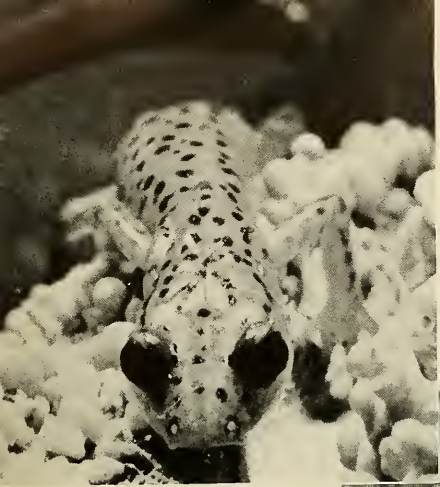
(Above) A tapestry of bats: 14,500 individuals in a single mass, Marvel Cave, Missouri. These bats (Myotis grisescens) *hibernate here and probably pass the summer in caves several hundred miles to the eastward*

(Right) Weird shadows in a Pennsylvania cave: little brown bats (Myotis lucifugus), *which enter this cave in October and do not leave until April*

Darkness

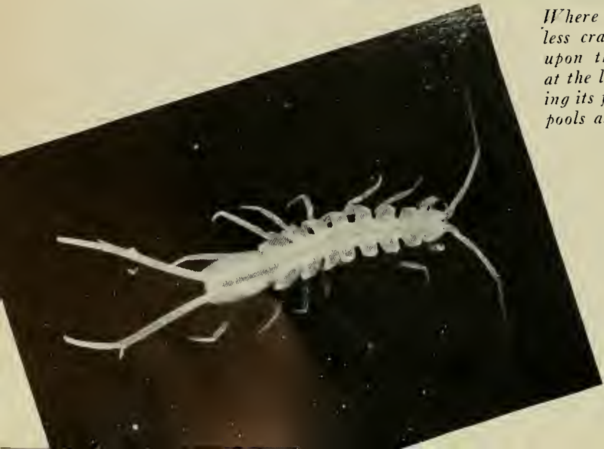
(Right) A fearless member of the underworld: the Allegheny cave rat, the eastern representative of the western pack rat. Unafraid of humans, he will frequently sit unconcernedly while you pass within a few feet of him

The famous blind fish, Typhlichthys osborni. *A hazardous mile trip along Hidden River, in the cave of that name, brought the photographer to the specimens shown here. Curio hunters have greatly reduced the numbers of blind fish in Mammoth Cave and elsewhere in Kentucky, where they were once numerous*



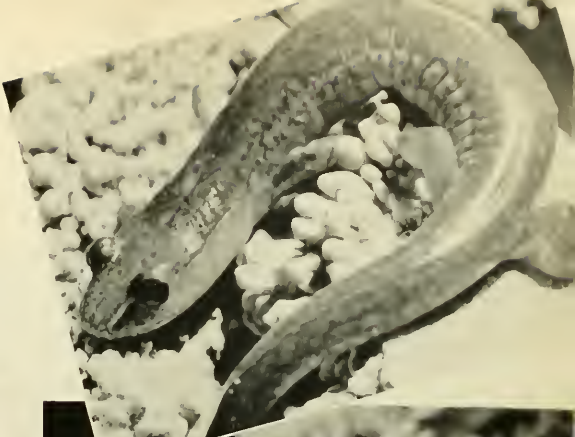
(Left) A flaming orange-colored cave salamander, Eurycea lucifuga. *Born probably from eggs laid far back in Nickajack Cave, Tennessee, this creature is gradually making its way to the entrance*

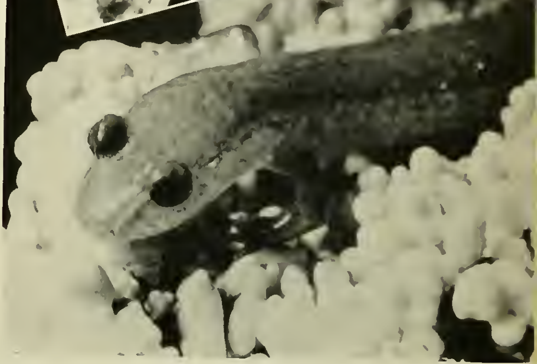
(Right) A difficult portrait: the blind cave salamander, Typhlotriton spelaeus, *to photograph which the naturalist crawled through long water-filled passages in the Ozark Mountain region*



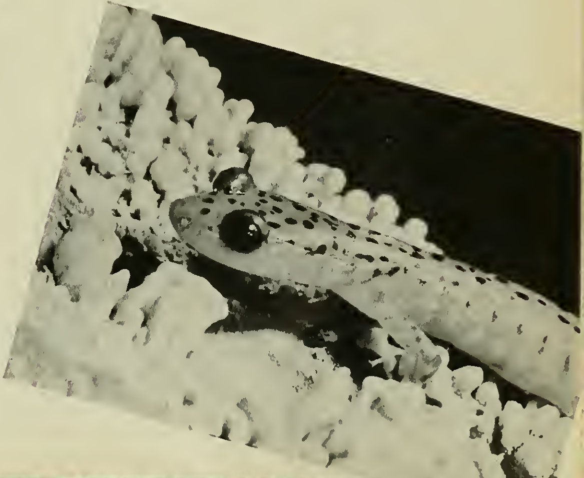
Where the blind eat the blind. Sightless crayfish and sightless fishes feed upon the sightless crustacean shown at the left. It was photographed making its feeble way through the shallow pools at Marvel Cave, Missouri

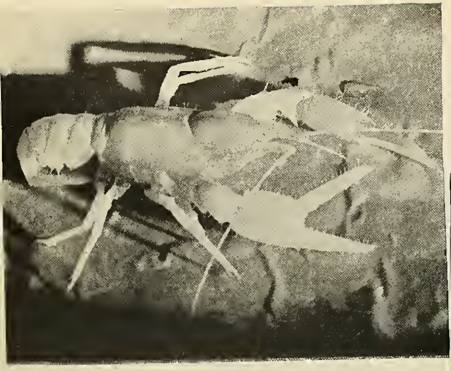
Ghostly pale in the rays of the flashlight was the salamander shown at the right, and so slippery that it squirmed right through the fingers of its captor. Though salmon in color, it is known as a "purple" salamander

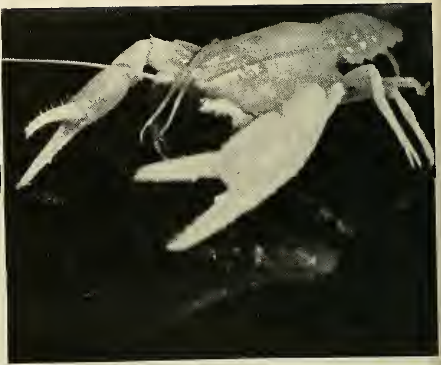




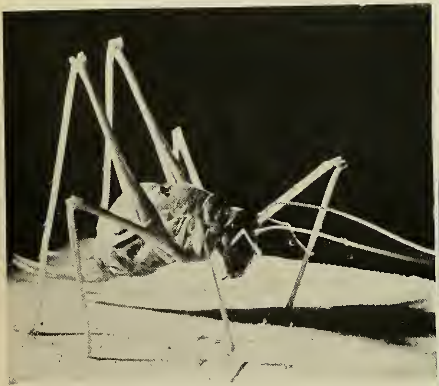
(Above) Another view of the so-called "purple" salamander, Gyrinophilus. *This specimen was photographed far back in Hidden Cave, Kentucky, but the species is also found outside of caves*
(Below) Orange-colored cave salamander



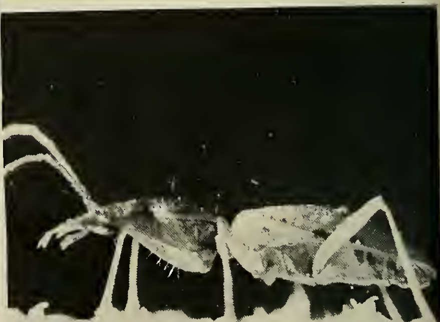




Happy is the collector whose flashlight reveals the strikingly beautiful blind white crayfish shown above. Sensitive hairs on its claws supplement its antennae as touch organs and compensate for its rudimentary eyes. This creature is particularly abundant in Smallin's Cave, Missouri



The cave cricket, Hadenoecus subterraneus, *is actually a long-horned grasshopper, with antennae three to four times the length of its body. It is wingless, but possesses well-developed eyes*



(Above) A tiny "giant" less than a quarter of an inch long: a blind beetle in Old Salt's Cave, Kentucky. Unknown to most visitors these creatures live under damp wood or paper or along the banks of shallow streams

Your New Books *by D. R. Barton*

Man Immortalized—The Dearth of a Nation—Eskimos—Island Warriors—Prophecies

HEADS AND TALES

- - - - - - - - - - - - by Malvina Hoffman

Scribners, $5.00

"My artist's soul was satiated and renewed during these journeys and I drank deeply of the peace and benediction of immensity."

IN 1930, Malvina Hoffman, was commissioned by the Field Museum of Chicago, to create the one hundred bronze figures that now stand in its Hall of Man.

This project was the crowning achievement of a life devoted to sculpture, and so it is but natural that in telling the complete story of the Hall of Man, the author should tell the story of her life.

Heads and Tales is such a book—a story within a story.

Miss Hoffman begins with the elopement of her musician father and her mother, touches upon her childhood spent in West 43rd Street, New York, proceeds to her student days abroad under Rodin, Mestrovic, and others, tells the thrilling story of a budding career—and of the world famous celebrities who sat for their portraits—Paderewski (to whom the book is dedicated), Pavlowa (who wept at her mother's death)—and of her intimate friendships with them.

This, in itself, would make a book—but suddenly scenes change. You see the war-wrecked Balkans through her pitying eyes—and then she embarks on her greatest adventure.

Miss Hoffman journeyed around the world, seeking out every place, however great or small, that any group of humans called "home." Studying, talking to, living with the subjects she was to immortalize in bronze. Many of them, she knew, as she made her preliminary drawings, were doomed to rapid extinction. Others she saw in dire straits she was powerless to relieve, and the immensity of her task flooded in upon her. All this is recorded in a vital, brilliant book, abundantly illustrated with examples of her art and scenes that have influenced her thought.

Now, your reviewer feels it his duty to warn you that, at bottom, *Heads and Tales* are a woman's memoirs. And that when a woman writes her memoirs she achieves a warmth of emotion that seldom, if ever, finds its way into the similar work of a man. But there is one fault that seems indigent to all works of this nature. It might best be described as a certain lack of self-restraint which makes for misplaced emphasis, and—particularly when the author is an artist dealing with science—a tendency toward dangerous assumptions. When she insists on, "artistic freedom to select at least the best possible representative of a race, and not the ugliest"—she is approaching a confusion of terms. The inner workings of Nature are not governed by the touchstones of human aesthetics—purity of either line or strain are apparently not her ultimate goal.

This fact has, incidentally, been ignored by certain Germans in the formulation of their political philosophy—and while on that subject, your reviewer is forced to confess, that the philosophy expounded by Miss Hoffman at the close of her book is not over meaningful to him.

RICH LAND, POOR LAND

- - - - - - - - - - - - - - by Stuart Chase

McGraw-Hill, $2.50

"A lovely, vital continent has been outraged and betrayed."

STUART CHASE'S book leaves you one comforting thought—the grass will not grow in the streets of our cities. Unhappily, however, for your peace of mind, it will not grow anywhere unless something drastic is done about a nation-wide conservation of natural resources.

Rich Land, Poor Land, is a clear-eyed expert's final report to his countrymen on the state of the nation, and is probably the most skilfully contrived inventory in history.

The forests, streams, wild life, farm lands, coastal waters and minerals of a vast continent are flung into Mr. Chase's utterly honest scales, and in nine cases out of ten, found desperately wanting.

From the moment white men first began seething over the Alleghenies, to the present day, the country has been settled, operated, and scandalously exploited under the concept of infinity. Next to nothing was done about conservation. There was always more land—plenty of it—farther west. Always more trees, more birds, fish, coal. Hence, the lumber baron's laconic philosophy of "cut out and get out." Hence, the bare hillsides. Hence, the floods. Hence, the death of the last passenger pigeon in 1914, and the disembowelment of a continent beyond all reason.

Nature spent thousands of years slowly accumulating her bounty. Came "the white-faced blight," and two centuries of organized rape. One truth shines out above all others in this book—the mechanics of speculative exploitation for quick profit are simply not compatible with the eternal laws and processes of Nature. We have worked against Nature for too long and retribution is at hand. We must either utilize every atom of accredited scientific knowledge in an effort to heal the wounds ignorance has inflicted on the living tissue of these United States, or we will bleed her to death, and as a consequence be faced with starvation.

Nor are there ways of escape through the miracles of synthetic chemistry and technical improvements. They too, the author clearly demonstrates, are dependent in large measure on conservation.

As well turn a flock of school children loose in a highly equipped chemical laboratory, and expect no ill effects, as throw open the resources of a continent to a horde of incredibly energetic, but appallingly uninformed people—endowed with the insight of a pawnbroker, the foresight of a prize heifer. They were plainly not responsible for their actions. The devil of it is that we are.

Leather-lunged spokesmen of certain organizations in our midst are currently prating about the debts our children will have to pay. These gentlemen should turn to Mr. Chase's book. They will find therein material aplenty for their cause; facts and figures so adroitly arranged, arguments so brilliantly presented, that they could be inserted chapter by chapter into any oration of the broadest appeal. Perhaps this may come about.

Who can tell?

LIFE OF THE SHORE AND SHALLOW SEA - - - by Douglas P. Wilson

Ivor Nicholson & Watson 12/6

HERE is a popularly written, finely illustrated book on the sea life that abounds in the waters surrounding the British Isles down to about the one hundred fathom line. Laity as well as the professional biologist will find a wealth of fascinating material within its pages. The author, Mr. Douglas P. Wilson, M.Sc. is Assistant Naturalist to the Marine Biological Association, at Plymouth, England.

THE REPTILES OF NORTH AMERICA - - - by Raymond L. Ditmars

Doubleday, Doran, $6.75

THE first edition of this book appeared 29 years ago under the title of *The Reptile Book.* Since that time 28 new species of snakes, 47 lizards and 10 turtles have been discovered, and many new sub-species have been named. Doctor Ditmars, probably the country's foremost authority on reptiles, has undertaken the formidable task of rendering a wholesale revision of his book. He has rewritten nearly all of his earlier classifications, added fresh ones, furnished new identification keys and brought the work completely up to date. There is no phase of reptile life that is not touched upon.

Intimate observations on the habits of snakes, lizards and turtles, in wild state as well as captivity are included. Many interesting comments on the human approach, and the authentic cures for various snake bites are given in full detail.

The new edition is a surpassingly handsome example of the publisher's craft. The type and paper present the utmost in readability. The text is embellished by eight full color plates and more than 400 striking photographs from life.

No effort has been spared in creating a book that is both an exhaustive guide to the identification of all reptilian species inhabiting the United States and Northern Mexico, and a fascinating collector's piece.

MORE SIMPLE SCIENCE

by Julian Huxley and E. N. da C. Andrade

Harper and Brothers, $2.50

MORE SIMPLE SCIENCE is a sequel to the co-author's previous work *Simple Science,* and like its predecessor combines accuracy and readability in such seamless fusion as to rank high among the most enlightening books of the day.

More Simple Science deals with the earth we live in, its scientific history, what it is made of, how creatures come to life in it and how all this should influence the conduct of our daily lives.

The forests, streams, wild life, farm lands, into friendly contact with the basic principles of chemistry, physics, biology and human physiology. The sequel cleanses geology, chemical agriculture, human and animal embryology, of the bewildering documentation with which they are too often surrounded, and presents them in shining clarity before the reader's eye. But this is not merely an easily digestible Baedeker of science. Messrs. Huxley and Andrade are motivated by a nobler aim. Their book is calculated to instil in the common man a comprehensive understanding of himself and his natural environment; to equip him to think about every-day problems accurately, and to make his decisions from an informed point of view. And, in a world where the theory of democratic social order is threatened on every side, what purpose could be more praiseworthy?

"Without science and the scientific spirit," we are warned, "we shall just drift along; with their aid, man may be able to learn how to control his own destiny."

SWISH OF THE KRIS

- - - - - - - - - - - - - - by Vic Hurley

E. P. Dutton & Co., $3.00

"The Moro is poised at a crossroad. He can accept the peace the Filipino offers or he can, with equal facility, pick up the bloody kris."

VIC HURLEY has written an attractive, but none the less, exhaustive book on the history and entire social structure of the Moros, unconquerable inhabitants of Mindanao in the Philippines.

The *kris* can be longer than the European sword, or as short as the stiletto. Whatever its length, the blade's keenness is unsurpassed. Wielded by the Moros, it has been the tangible means of keeping a remarkable race invincible—first, at the dawn of the Christian era, as conquerors of Mindanao; then for nineteen centuries of resistance to native invaders, Spain and the Americans. There are about five hundred thousand Moros compared to the twelve millions in the total population of Mindanao, yet their race is so hardy an organism that, *kris* in hand, they alone have remained independent while the rest of the Philippines have succumbed to the "civilizing" influences of the governments of Spain and the United States. Mr. Hurley's book is an investigation of this almost unique phenomenon, and a search for its causes.

Warriors by birth, the Moros have always scorned agriculture or any other peaceful means of livelihood. They have even developed an art of poisoning fish in such a way that they remain edible, rather than concentrate on organized fisheries. They are chronic pirates, marauders, pillagers—murdering for no other purpose than to test the blade of a new *kris*. Such a race was made-to-order for the Mohammedan religion they espoused. Successive generations, reared in the faith, are trained to battle believing that bravery spells paradise, the slightest cowardice, hell.

These facts, Mr. Hurley feels, explains Spain's inability to subdue the Moros. Even the cruelties of the conquistadors, so efficacious in Mexico and Central America, were powerless against these brown defenders of Islam. And the Spaniards tried every means in their quite unpleasant repertoire, as the author shows by quoting from their own records.

Swish of the Kris, is at once a document of sociological importance, and a fantastic story of unbelievable brutality and barbarous living. Mr. Hurley's close association with the Moros has given him an admiration for their indomitable courage, which is carried over to the reader.

THE STUDY OF MAN

- - - - - - - - - - - - - by Ralph Linton

Appleton-Century, $4.00

ANTHROPOLOGY is marked by the characteristic of every young science, in that it is divided within itself into divergent schools of thought. Doctor Linton feels, however, that his field of endeavor has reached sufficient maturity to warrant a clean cut, comprehensive, and unbiased book that will serve both the layman and the student, as a well-founded introduction.

This is what *The Study of Man* was intended to be—and what it is. The author is willing to go just so far with each of the warring factions—but he steadfastly declines to go the whole hog. He takes what he considers the most valuable contribution of each, and includes it in a text that treats accurately and fairly every aspect of Anthropology—human origins, the significance of racial differences, marriage, tribe and state, discovery and invention, orientations of culture. In addition he submits a new theory of race which corresponds more closely to the tenets of modern biology—and establishes a link between culture and animal behavior.

THE ESKIMOS

- - - - - - - - - - by Kaj Birket-Smith

E. P. Dutton, $5.00

". . . it has been my goal to write in such a way that it can be understood by anybody."

KAJ BIRKET-SMITH may have left some stone unturned in his treatment of *The Eskimos,* but if he did, only another expert could put a finger on it.

The Danish Anthropologist discusses every aspect of Eskimo life. Language, crafts, hunting methods, house-building, diet, taboos, religion and philosophy—all are portrayed in a vivid, pictorial style ably preserved by his translator Mr. W. E. Calvert. His book, amply illustrated, is truly one that can be understood by anybody.

No branch of the human race, is faced with so severe and grudging an environment as these fur-clad hunters of the north. Mr. Birket-Smith acquaints you with each problem of existence as it presents itself to the Eskimo; tells of the difficulties of sledging, how the sledge-runners are lubricated, and how a certain clergyman maintains that "oaths used when sledge-driving will not be included in the account on Judgment Day." He takes you into soot-blackened igloos, and on hunting trips where Eskimos travel great distances on foot and aboard their treacherous but silent kayaks, stalking seals and caribou by disguising themselves as, and emulating the actions of, these animals.

Some of the Eskimo's habits will horrify you a little—the half-digested contents of a caribou's stomach are regarded as a delicacy—but don't feel too superior, for the garments made by Eskimo women, are indicative of far better taste than some of the night-marish creations, used by Parisian couturiers to stimulate sales.

PRIDE OF LIONS

---------- by Bertram F. Jearey

Longmans, Green & Co., $2.50

"We were out to photograph, not to kill."

IN choosing his title, B. F. Jearey shows an almost Shakespearian flair for double meanings. Technically, "pride" is to lions, what "pack" is to wolves —and while Mr. Jearey's book most certainly is concerned with large numbers of lions, and teems with striking photographs of same, its fundamental concern is with pride, the human characteristic, as it is evinced by the king of beasts—the pardonable conceit that is his royal birthright.

Mr. Jearey likes lions. They charge his automobile, make fierce war at his arm's length, stalk his camp at night—yet they fascinate him so much that he exclaims, while watching cubs devour their first kill, "The snarling, spitting ferocity of them was delightful!"

Mr. Jearey feels that his own species have been too long peering at Leo through the sights of rifle barrels, and that such tactics do not develop a true understanding of him, nor contribute toward a curtailment of the needless dread in which he is held by most humans. He suggests a more intelligent and friendly instrument of the chase, and proves by an astounding collection of photographic trophies, upheld by a brightly written text, that not one iota of danger, thrill, valor or exaltation, is removed from the lion hunt wherein the camera is substituted for the firearm.

Pride of Lions, is a series of interpretative sketches, often witty, always entertaining—of lion life in particular, and animal life in general, as it is lived in the African Veldt.

Its author has words of praise for Kruger National Park, and a message of hope that, through its good work, the relations between men and lions will in the future, be characterized less by gun and claw, and more by a mutual understanding and respect.

THE GAUCHO MARTIN FIERRO

------------ by Jose Hernandez

Translated from the Spanish by Walter Owen

Farrar & Rinehart, $3.00

"By the song I sang in the days gone by
That now I sing to you."

THIS Book of Verses may well be called the national epic poem of the Argentines. The first part, *Martin Fierro*, was published in Buenos Aires, in 1872, the second part entitled *The Return of Martin Fierro*, appeared seven years afterward. The poem, alive with the earthy vernacular of its hero, and compelling in the passionate realism of Hernandez's descriptive powers, has been rendered into English with superlative skill by Mr. Owen. It is the very stuff of folklore. Part one is a comprehensive depiction of the life and times of the Argentine Gaucho, part two tends more toward a portrayal of the political corruption and social injustices that attended the arrival of the age of materialism in South America. An age which had no evolutionary use for the Gaucho, and which, therefore, practically exterminated him.

In Mr. Owen's own words the poem is ". . . a tale of bygone days . . . and of a time which seems to keep closer measure with man's heart-beats than the age which has succeeded it."

Martin Fierro was a hard fighting, hard drinking, hard riding hombre. The prototype of his kind, he has much in common with our own cowboy of fictional fame, and should easily prove as colorful a character as any in our vast store of frontier literature.

The book had a tremendous critical success in England, and the first copy to leave the presses was accepted by Edward VIII, then Prince of Wales.

SALAR, THE SALMON

---------- by Henry Williamson

Little, Brown, $2.50

"Salmon, stream-shapen and wave-wrought, revealed by only a momentary bulge in the smooth bend of water."

NINE years ago Henry Williamson was awarded the Hawthornden prize for his remarkable novel, *Tarka, The Otter*. In his new book he strengthens his enviable reputation as one of the most gifted Nature writers of our time. *Salar, The Salmon*, tells the story of the salmon, from birth to death. Tells it dramatically, epitomized by the life and death of Salar its hero.

Mr. Williamson has literally lived among Salmon. There is a home-made hatchery almost at the doorstep of his house. He has spent days, nights, years patiently observing them.

His book is an incomparable fusion of scientific accuracy and the gift of translating the authentic workings of Nature into a beautifully liquid prose.

Salar's adventures are the adventures of all Salmon. He has his enemies—the blood-sucking lamprey, the fishermen, and man-polluted waters—to name a few, and his friends—Trutta, a very old sea trout, and Gralaks, the grisle.

Mr. Williamson seems to know how Salar feels. This sympathy between hero and author is due partly to painstaking observation and scientific deduction, partly to a secret communication between artist and subject which makes the reading of this book a rare and delightful experience.

THE STORY OF PROPHECY

- - - - - - - - by Henry James Forman

Farrar & Rinehart, $3.00

"Our own crucial period, through which we are now passing, has been long foretold, with considerable detail, by a very chorus of voices crying in the wilderness."

PROPHECY, as treated by Henry James Forman, is not a matter of scientific calculation making possible the prediction of future events. It is rather, a mystic phenomenon manifesting itself in trance-like revelations to persons of unusual clairvoyance. *The Story of Prophecy* is an historical study of predictions made throughout the centuries. The author recalls the importance of the Delphic Oracle of classical times, and the astrologers of the middle ages. He cites numerous examples of prophecies which have been fulfilled, both in the case of individuals, and of nations. Records indicate that there were at least twenty prophets of the French Revolution, making their predictions in considerable detail, at a time three centuries prior to the event.

Prophecies of a very real interest to the present-day reader are allegedly inherent in the structure of the Great Pyramid of Cheops. Constructed at about 2900 B. C., it preserves in its mathematical dimensions and proportions, all of the scientific knowledge of Ancient Egypt, together with an elaborate prophecy of world events from Biblical times until the year 2001 A. D. Mr. Forman enumerates many of the prophecies of the pyramid, as deciphered by a vast contemporary school of "pyramidologists" who attribute great significance to the revelations of ancient Egyptians. The latter sections of the book are devoted to a description of these and other prophecies relating to the immediate future of the world today. All evidence seems to point to the conclusion that the greatest prophecies have been directed toward our own era, that the Pyramid of Cheops was constructed for the especial purpose of revealing knowledge to the world of the Twentieth Century, A. D., and that we are now about to enter an age of great awakening and glorious intellectual and material expansion. Mr. Forman brings our day even further into the limelight by saying. "To many prophets and in numerous prophecies, the year 1936 marks a great turning point in human life and in human destiny." Optimistically, he shows that this turning point is the initial step toward a new golden age.

In evaluating the significance of this wealth of prophecy, the author points out that in our civilization, most people do not admit that they believe in prophecy. However, he remarks, "A little closer inquiry will lead the reader, as it has led the writer, to conclude that almost everyone believes in prophecy—*with the possible exception of the average scientist.*" Despite a lack of scientific credentials and after careful consideration of the material at hand, your reviewer stands pat—numbering himself among the infidels.

SKYWAY TO ASIA

- - - - - - - by William Stephen Grooch

Longmans, Green, $2.50

"If you've never looked a ten-foot shark in the eye at close range, you've missed a thrill."

PERHAPS the most fascinating thing about this book is its jacket.

Mr. Grooch's publishers have really outdone themselves in the fine art of giving a volume eye-appeal on the display-shelf. Not that the book itself isn't worth your while. It is. But that jacket is a handicap. The book has never been written that wouldn't have a hard time living up to it.

Skyward to Asia, is a rollicking, breezy account of the first North Haven Expedition, sent forth by Pan American Airways to establish commercial air bases across the Pacific Ocean. Mr. Grooch, aviator and ex-navy man, was in charge of the expedition which established stepping stones for the clipper ships at Midway, Wake, and Guam Islands. His is a personal record, not an official one and he writes it with verve, skill, and abundant humor. Many difficulties had to be surmounted en route. Supplies were delayed, hands were mashed handling the heavy machinery, wells had to be dug—but all in all, when you have finished it, your temptation will be to look out at the city's street and sigh.

Mr. Grooch has an eye for Nature too. He describes the birds, fish and wild life . . . that thrive in these islands—his observations on the Gooney and the Hermit crab being particularly noteworthy.

SEVENTY YEARS OF IT

- - - - - - - - - by Edward Alsworth Ross

Appleton-Century, $3.00

"I learned the inexorable properties of things"—"if you don't tackle them as they really are, you are never able to manage them."

SEVENTY YEARS OF IT is the autobiography of one of the country's most out-spoken educators, Professor Ross of the University of Wisconsin's department of Sociology.

All his life he fought for the things he believed in, hated deceit, and bowed only to the goddess of truth to whom his life's work is dedicated.

His book is one of the most ruggedly honest achievements that has come along in many a day and expresses in a full-flavored, incisive style, a liberal's outlook on the world at large.

Mr. Ross has explored China. He has traveled South America, Mexico, South Africa, India—and was dispatched to Russia shortly after the revolution, by the American Institute of Social Service.

In his autobiography, he has set down an impartial sociologist's keen observations on everything that came beneath his gaze and has taken sides courageously in many of the controversies, with which our country is faced today.

THE MAMMALS AND LIFE ZONES OF OREGON - - - by Vernon Bailey

Superintendent of Documents,
Washington, D. C., $.75

THIS book is a four hundred and sixteen-page illustrated report, by Vernon Bailey, who was retired in 1933, after forty-six years of active work for the Biological Survey.

The object of the book is not only to provide as full information as possible, but also to give an impetus that will enable others to go ahead with future studies, until far better means for understanding, appreciating, managing, and controlling our native fauna are attained.

NOVITATES

No. 877. Notes on the Anatomy of the Viscera of the Giant Panda (*Ailuropoda melanoleuca*). By H. C. Raven.

No. 888. On the Phylogenetic Relationships of the Giant Panda (*Ailuropoda*) to Other Arctoid Carnivora. By William K. Gregory.

BULLETIN

Vol. LXXII, Art. I.—Further Notes on the Gigantic Extinct Rhinoceros, *Baluchitherium*, from the Oligocene of Mongolia. By Walter Granger and William K. Gregory.

Vol. LXXII, Art. II.—Some Features of the Cranial Morphology of the Tapinocephalid Deinocephalians. By Lieuwe D. Boonstra.

Vol. LXXII, Art. III.—The Cranial Morphology of Some Titanosuchid Deinocephalians. By Lieuwe D. Boonstra.

Vol. LXXII, Art. IV.—Hyraxes Collected by the American Museum Congo Expedition. By Robert T. Hatt.

Science in the Field and in the Laboratory

Birds of the Alps—Animals from Colorado—Pacific Pearls—Lectures on Gems.

Harry Snyder Colorado Expedition, 1936

George G. Goodwin, Assistant Curator, Department of Mammals, returns from field work in Colorado, bringing back over 300 specimens. He visited high regions on the western slopes of the Rocky Mountains in northern Colorado, and carried on work in three different types of country. His first camp was in sagebrush and arid regions; later, he camped on the open rolling range country above timberline at 10,000 feet, and his last camp was in timber country at 8000 feet, near Trappers Lake. He brought back specimens of the coney from the rock slides on the mountain tops. Specimens of the rare water shrew from the cascading mountain streams—these little creatures, no more than two inches long—rank high among the best swimmers of the non-marine animals. They can swim, dive, float, run along the bottom of a pool or creek, and actually walk on the surface of the water. He also brought back specimens of the pigmy vole, from the high, dry, mountain ranges, 13 striped and spotted spermophiles, golden mantle chipmunk, badger, long-tailed weasel, jumping or kangaroo mice—queer little animals that sit upon their hind legs and jump like kangaroos—and other species.

Mr. Goodwin's research work was carried on under diversified conditions. He experienced the torrid heat and drought, cloudbursts and forest fires, dust storms that blotted out the landscapes—and the beautiful, clear air of the summit of the Rocky Mountain tops. He lectured at the Women's Club in Meeker, and entertained the local people with two showings of motion pictures at the theater.

This collection, along with specimens he brought back in January from Colorado, brings to the Museum a good representation of all the mammals in summer and winter coats found in that region.

New Size and Title for Planetarium Bulletin

The Hayden Planetarium publication, *The Drama of the Sky*, will change to a larger size beginning with the November issue which will be entitled *The Sky*.

New York Academy of Sciences' New Quarters

The American Museum has furnished the New York Academy of Sciences with new and spacious quarters located on the fourth floor of the Roosevelt Memorial Hall. There is ample room for about one hundred members to convene, as well as equipment for illustrated lectures.

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Dr. Miner's Expedition for Pearl Fisheries Group

The serrated mountains above Honolulu's beautiful harbor glistened in the sun as the steamer *Lurline* ended her voyage from San Francisco on September 3rd. Among the passengers crowding her decks were Dr. R. W. Miner, Curator of Living Invertebrates at the American Museum, and Messrs. Wyllys Betts and Chris Olsen his assistants.

They were accorded the celebrated effusive welcome of Hawaii, were lavishly photographed in floral garlands, and were later met by Mr. Fred Smyth, Museum Bursar, and Mr. Templeton Crocker, under whose auspices Doctor Miner and his staff are conducting an expedition to collect important material for the Pearl Fisheries Group in the Hall of Ocean Life, at the Museum.

This expedition left Honolulu, September 7th, aboard the boat *Zaca* which maintains a fully equipped laboratory. Christmas Island, about 1200 miles southwest of Honolulu, is the first port of call. From this point, it is planned to visit Penrhyn Island, Pago-pago, Apia in British Samoa, and on the return trip to stop off at Fanning Island. The expedition took five brass boxes of different types to be used in an extensive program of underwater photography, which, it is hoped will add considerably to the knowledge of underseas life.

If all goes well, the expedition will disband at Honolulu on the 13th or 14th of November.

Free Lectures on Gems

The American Museum will offer a free course of four informal talks on "The Appreciation of Gems," by Herbert P. Whitlock, Curator of Minerals and Gems.

The series and dates are—"The Story of the Jade: I," on Saturday, October 24th, at 4:00 P.M. "The Story of the Jade: II," Saturday, October 31st, at 4:00 P.M. "Amber and Near-Amber," on Saturday, November 7th, and "The Work of the Lapidaries of Imperial Russia," on November 14th, at the same time.

PROBOSCIDA, Volume I. Henry Fairfield Osborn's Last Work.

For many years before his death on November 6, 1935, Dr. Osborn was engaged upon this monographic revision of all known fossil and existing species of Proboscidea (mammals of the elephant tribe, usually provided with a proboscis, or trunk).

At the time of his death the greater part of Volume I, was already in type, but there was still a great deal to be done: many drawings and maps had to be made; there was much to add to the text and to the appendix from the author's later notes; the bibliography, table of contents, list of illustrations, etc., had to be completed; finally the whole volume had to be virtually reset and corrected.

Volume II, still awaits completion from the materials left by the author; but it is hoped that it will be published within the coming year (1937).

This work is assuredly one of the greatest documents bearing on the evolution of the mammals.

New Alpine Bird Group

A new addition to the magnificent Hall of the Birds of the World in the American Museum of Natural History—depicting bird-life of the high Alps—was opened to the public on Sunday, September 13th. The group, given to the Museum by Mrs. Carll Tucker, contains no less than twenty-one species of birds shown in an Alpine scene of trees, shrubs and flowers which is as artistically beautiful as it is scientifically correct. The spectator is transported to the upper slope of Riffelalps at timberline. In the background the snow-clad peak of Matterhorn pierces the sky.

Dr. Ernst Mayr of the Museum's Department of Birds, which is headed by Dr. Frank M. Chapman, selected the locality for the exhibit as well as the bird-life presented in it.

The group was designed and the background painted by Francis Lee Jaques from field studies made by him in July, 1935. At that time, he also collected the accessories for the foreground. The preparation and installation of these accessories was done by George E. Petersen under the supervision of Albert E. Butler, Associate Chief Arts, Preparation and Installation, Dr. James L. Clark, Director. The birds were mounted by Raymond Potter.

"Birds are not abundant in the high Alps," said Dr. Frank M. Chapman, in explaining the group. "But those that are there tell a story of the remote past which forms an important contribution to our knowledge of the geologic history of these mountains.

"The upper, or Alpine zones of high mountains are like islands in the air. Many of the animals and plants inhabiting them are as effectively isolated by the warmer climate below them as though they were indeed occupants of oceanic isles. It seems evident, therefore, that they have reached their present homes under conditions which no longer exist and their presence, consequently, often gives us a clue to their origin and the geologic history of their habitat.

"When, therefore, we find such Himalayan birds as the Wall Creeper and the Snowfinch in the high Alps we realize that they doubtless reached there over the mountain highway that in the Tertiary Period connected Asia with western Europe. Possibly the rhododendrons of the Alps followed the same route.

"So also the Arctic Ptarmigan and the Redpoll doubtless came to the Alps when the ice cap of the Glacial Period extended as far south as central Europe. Finding a congenial home at a high altitude they remained there when the ice retreated. Other birds in the group have extended their range from the Palaearctic Zone at the base of the mountain upward to timberline. From this level they may retire to lower levels in the winter or they may migrate southward to Africa, such as do the House Martin, Wheatear, Black Redstart, Mistle-Thrush and Cuckoo."

The Museum staff feels that this exhibit is one of the finest yet offered to the public, and intends to maintain this standard in all forthcoming displays.

Bird-Life—Of The Palaearctic Alpine Zone

A view of the Zermatt valley and the Matterhorn, in Switzerland, from an altitude of 7000 feet at timberline.

Penguins in Captivity

The Emperor Penguins obtained for the Chicago Zoölogical Society by the Second Byrd Antarctic Expedition have all died of a respiratory disease in the Society's park at Brookfield. This latest attempt to maintain in captivity the most southerly breeding bird in the world has thus led to the same results as all previous experiments.

With many other species of penguins, however, success has been much more marked, though less so in America than in Germany and Great Britain. Well deserved good fortune, for example, has crowned the long efforts of Mr. T. H. Gillespie, Director of the Zoölogical Society of Scotland, at Edinburgh. This summer Mr. Gillespie has under his charge 160 penguins representing five species, and a goodly number of these birds are one or two generations removed from their wild ancestors. King Penguins, Gentoo Penguins, and South African Penguins have been bred in captivity at Edinburgh for several years. During 1935, the first Rockhopper Penguin was hatched and reared. A Ringed or Antarctic Penguin also came through the incubation period and broke out of its shell, although it survived thereafter only four days. During the present season the adult Ringed Penguins have been nesting and sitting again and better luck is hoped for.

Mr. Gillespie writes that with 35 healthy King Penguins and an even larger number of Gentoos and Rockhoppers, he would gladly sell or effect exchanges with institutions in America eager to obtain well acclimated penguins.—R. C. M.

PARENTS!

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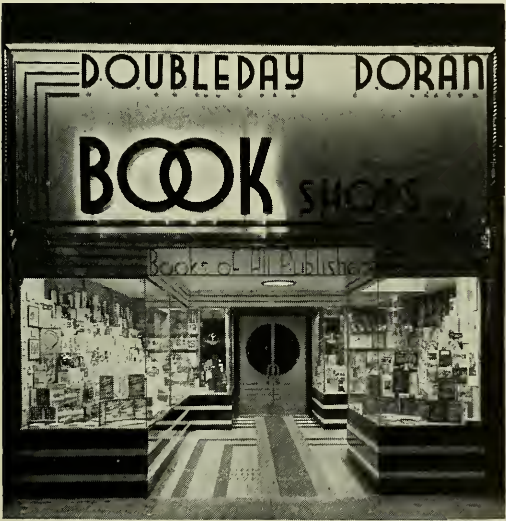

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RECENTLY ELECTED MEMBERS

SINCE the last issue of Natural History, the following persons have been elected members of the American Museum:

Annual Members

Miss Mary C. Wheelwright

Doctors Aaron Bodansky, Minerva Blair Pontius

Colonel H. S. Hansell

Messrs. Charles Bellinger, Clarence M. Clark, Bobb Schaeffer, Harley L. Stowell, H. J. Wolff

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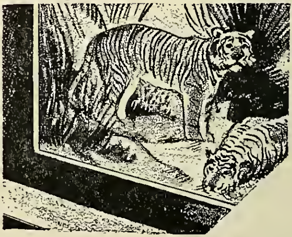

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

VOLUME XXXVIII ★ ★ ★ ★ NOVEMBER 1936

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

ADVERTISING: Sherman P. Voorhees, The American Museum of Natural History.

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Horses and History

The story of the horse from earliest times: his place in war, peace and sport; and his claims to a lasting position as man's ally

By GEORGE GAYLORD SIMPSON
Associate Curator of Vertebrate Palaeontology, American Museum

"When I bestride him, I soar, I am a hawk: he trots the air; the earth sings when he touches it; the basest horn of his hoof is more musical than the pipe of Hermes . . . his neigh is like the bidding of a monarch and his countenance enforces homage." (Shakespeare).

BEFORE the dawn of history the thunder of flying hooves sounded among the green valleys of Gaul, across the broad steppes of the Volga, and the Caspian, and over the plateaus and the deserts of Tartary. That ancient singing of hooves, like the clash of distant cymbals, was to mingle with the voices of men and to go echoing down the long corridors of history. Indeed it was to be history, for the horse was to carry on his back the fates of nations and the hopes of civilization. When, in the course of our rise in wonder and in pain from our brute ancestors, primitive man first crept silently along shaded paths stalking dun and shaggy wild ponies, he created a partnership that was to help shape the destinies of both man and beast forever after. Hawk-like Arabs, fierce Tartars, mail-clad chevaliers, little yellow men and lean red men, innumerable hosts, were to woo the horse and to live with him and by him.

It is true that when horse and man first came in contact the beginning was conflict and not partnership. To the cave man, horses were big game and not companions or allies. At Solutré, in France, one of the places where the histories of men and of horses first begin to unite into one twisted thread, there is a great pile of débris left by cave men who lived toward the close of the Great Ice Age, and that pile consists very largely of the broken bones of horses. There are thousands upon thousands of these bones—it is sometimes estimated that they represent nearly a hundred thousand horses—and it is evident that all these animals were eaten. From that time on (and probably from a date still more remote) there is evidence that horse-flesh was an important element in Stone Age diet, sometimes almost the only source of food. Perhaps partly for amusement but surely also for magical reasons, these remote ancestors of ours were given to portraying the animals important to them, and among these vivid portraits still preserved are dozens of horses, small statuettes, engravings on bone and ivory, and paintings on the walls of caverns. Some of these representations have seldom been surpassed in artistic spirit and, although all are to some extent stylized, many are so accurate that we can identify the exact race of wild horse intended. Most of them were closely similar to the only true wild horses left in the world today: the horse of the Gobi usually called Prjevalsky's horse.

(Left) A splendid example of the Grecian æsthetic conception of the horse, dating from near the close of the Athenian Empire. Although mediocre horsemen, the cultured Athenians saw in the horse an artistic ideal

Domestication

There is, however, no conclusive evidence that the men of the Stone Ages ever domesticated the horse, although their use of horses as food and their keen interest and observation may properly be considered as the first step that was to lead to domestication. When and where domestication first took place, or indeed whether it did not occur at more than one time and more than one place, may never be exactly known, but we may infer that it was probably somewhere in central Asia and around 4000 B. C. Horses first appear in regular, written history between 2000 and 1500 B. C. The use of horses was then known in China, apparently from painful contact with the wild hordes of central Asia who were then already mounted, and also in western Asia and the Mediterranean.

There is still extant an Egyptian song of Rameses II, about 1350 B. C., in which highly developed use of horses in war is shown. "I am to them like Baal in his season," the king is made to boast, "their twenty-five hundred chariots are hacked to pieces before my steed." The common and abundant use of horse-drawn vehicles surely implies a long previous history of domestication, and indeed there is reason to believe that horses were known to both Egyptians and Babylonians long before this time, but it was only after 1500 B. C. that they became generally diffused in this area. Even then for a long period these civilized and sedentary people used the horse almost exclusively for military purposes and then almost entirely for drawing chariots. True cavalry was for them a late development and one to which they never became entirely adapted.

A dark horse

When horses thus first appeared on the western scene, there is little doubt that some of them, at least, had been ridden into the light of history out of the darkness of interior Asia, carrying barbarian raiders and nomads. The common type of barbarian horse, then as now, was similar to the cave man's prey and to the wild horses of Eurasia, dun-colored animals, not much over 13 hands high (4′ 4″) with short legs and large, coarse heads. At almost the same time, however, there appeared a very different sort of horse, likewise small by later standards, but dark in color (typically bay), delicate and fleet in build, with sensitive heads. There is no agreement as to the ultimate origin of these horses, but when they first appear they seem to be typical of northern Africa. Like so much supposedly dry ancient history, these facts are not really remote from our own lives. The blood of these dark horses flows now in the veins of every race-horse, polo-pony, hunter, and even of our more prosaic cart and plow horses. Apart from this, their appearance and their spread have repeatedly been a decisive influence in history. Were it not for them, our lives would now be profoundly different.

The Libyans or Numidians had such horses from a very early date, and not long after the first extensive use of horses in Egypt, the Egyptians were levying a tribute of horses on the nomad tribes to the west of them. The Libyans had chariots and are credited with the invention of the four-horse team, but they also and more commonly rode on horseback, and this before other Mediterranean nations habitually mounted. These horsemen were extremely mobile and swift and their light horses served them well, for the people themselves were slender and they reduced incidental weight to an absolute minimum. Greek paintings of about 600 B. C. show the Libyans, both men and women, riding astride, bareback, and themselves nude. In these paintings the horses have bridles, but later authors describe naked Numidians on unbridled horses, so that both steeds and riders performed in a complete state of nature.

The more civilized peoples of the eastern Mediterranean bred larger horses than either of the main purer stocks, Asiatic and north African, and in Persia and elsewhere lines of heavier crossbred animals arose. For developing and improving the qualities of these horses, the African stock was eagerly sought, and we find large sums being paid to the Egyptians for these blooded horses which they, in turn, seem to have derived from the Libyans. This crossing of Libyan horses, analogous to the Arabians of later times, with sturdier but slower northern animals is exactly the same process as has given us our thoroughbreds, and indeed almost all the breeds important in European history. This type of breeding arose several centuries before Christ, and, incidentally, before the Arabs had any horses.

In Greek art

The best horses of the Greeks are portrayed in the sculptures executed by Phidias for the Parthenon, and evidently were cross-bred horses of the type just described. Modern breeders remark that these stallions have numerous bad points and would have been hopeless in competition with our thoroughbreds, but the comparison is hardly fair and our thoroughbreds would undoubtedly have been considered second-rate by the Greeks. At any rate, they and their neighbors had succeeded in producing mounts that were strong enough to carry a well accoutred warrior, considerably heavier than the slender Numidians with nothing on before and rather less than that behind, and at the same time fast enough to compete with the smaller breeds of that epoch. Whatever one may think of this more practical aspect of the matter, the Greeks must have loved horses and these sculptures are among the most beautiful things ever created by the hands of man. Their lovely, simple lines, the rich and flawless texture, their sure achievement, and their lively and sometimes almost humorous spirit are all incomparably fine. Had horses never done anything for man but to serve as models for these works of art, they would yet deserve an honorable place in the history of the human soul.

Despite this evident love of horse-flesh and the presence of numerous well-bred horses throughout the Golden Age of Greece, neither the Greeks nor the Romans after them were really great horsemen. They developed cavalry, but as fighters they were usually at their best on foot. Some of the Greek and Roman so-called cavalry was, indeed, really mounted infantry, for on several occasions we read that the soldiers rode to the battlefield but dismounted to fight. The horse was not an intimate part of the daily life of the whole people, nor even an irreplaceable element in their civilization. This has generally been true of the more sedentary races, and was particularly true of the nations of antiquity for with them the horse was seldom used as a work animal, donkeys and oxen usually occupying this essential economic position. The man who could afford to keep a horse as a luxury in times of peace and to raise him above the ruck of the battlefield in times of war had already before the sixth century B. C. become a privileged aristocrat.

A sign of rank

"The air and gracefulness of sitting a Horse," says Don Quixote, "makes gentlemen of some and grooms of others," and so it has been throughout most of European history. From the Hippeis of ancient Greece to the Chevalier, Caballero, or Cavalier of today, the man on the horse is the gentleman, the aristocrat, and the man on his own feet can only look up, admire and obey. It is the horse that makes the man. Most of the old privileges of equestrians have worn thin in this mechanical age, but the habits of twenty-five centuries die hard, and who can deny that even now the horseman is something special, a man apart, or indeed more than a mere man? The man who owns a horse, especially if it is a horse that he does not need for any useful purpose, quite rightly feels himself to be in a distinctive class, and is so considered not only by fellow equestrians but also by the humble pedestrian. This is a relic of the ages when good riding horses were much harder to obtain than good motor cars are now, gave their owners a much greater advantage over the rabble, and were the invariable touchstone of aristocracy. Even the mounted policeman of today inherits a mantle of command and authority from the knights and nobles of old, and inspires a respect not granted to his motorized or unmounted fellows.

Chariots vs. cavalry

The development of good riding horses led to the decline of the chariot, and of horse-drawn vehicles generally, among the Mediterranean nations. While horses were then still principally an adjunct of war, it soon appeared that a chariot corps could not successfully combat well-trained cavalry, and the chariot became secondary in importance, was diverted to other uses, and finally disappeared altogether. The development of wagons and carriages used for transporting freight and people seems to have been largely independent of the rise and fall of the chariot. The Scythians, who lived in wagons and were apparently among the first to use them, were great horsemen who had both chariot and riding horses in abundance, but their wagons were drawn by oxen, and there is much other evidence that the horse's demotion to a beast of burden or a work animal was usually secondary. In central and northern Europe the use of the chariot survived longer than around the Mediterranean, and there is some evidence that the use of the horse as a work animal is older there. The survival of the war-chariot has been ascribed to the small size of the native European horse, and we know that the Gauls were eager to obtain Mediterranean horses for breeding and that they did eventually develop effective cavalry. By that time the horse was already their work animal, also, to an extent that to this day is not true of the Mediterranean countries.

Chariot racing

Long after the chariot had begun to decline as a useful implement, its use was kept up at Rome for racing, for which the Roman populace had an excessive passion. The four racing factions, which had their colors like those of a racing stable today, spent enormous amounts on these races and the charioteers were professionals, some of whom were as famous as any athletic world champion is today. The horses were mostly of Libyan blood. Chariot racing had, indeed, been a leading sport of the whole Mediterranean area for centuries before this, and racing with a ridden horse was begun at Olympia in 648 B. C. The winners of the great races were heroes beyond compare, and the horses themselves were fêted and commemorated in monuments and on coins. Poets sung their praises, and no channel swimmer ever received greater ovations from the people. At Olympia there were not only chariot races and mounted horse races, but also mule-car races.

It seems probable that the first time there were ever two horsemen at one place, the result was a race. All tribes and nations who ride horses at all run races on them, and almost as invariably there is some gambling on the outcome, from Patagonia to Mongolia and from New York to Shanghai. This is one element in the relationship between horse and man that is universal, and will probably be the last to disappear.

Even the use of horses for pure diversion, as in our circuses, is ancient in origin, for we read in Pliny that the Sybarites had trained their horses to dance to music at banquets. This feat was their downfall, however, for in 510 B. C. when they sallied forth on horseback to fight the wily Crotonians, the latter played the horses' dance music on flutes. The Sybarite horses danced and their riders were unseated and utterly routed.

Although the Greeks and Romans thus had all the elements of horse culture that have characterized the whole of European history, the fact that they were not great horsemen as a race was in each case an important element in their downfall. Macedonian dominance over the Greek cities can be largely ascribed to superior cavalry, and the struggles of both Greece and Rome with the nations of the Near East, time after time bringing them to the verge of ruin, were prolonged if not made possible by the eastern superiority as horsemen, despite inferiority in most other respects. Rome's bitter struggle with northern Africa was long dragged out by the better mounted, harder riding African troops. Rome did, however, draw auxiliary cavalry from this same region that saved the Roman army at least once during the early invasions of Gaul. The Gauls, also, seem to have been superior to the Romans in cavalry tactics, although at first they were not so well mounted. Finally when the barbarians swept down on Rome, they were mounted on the best war horses then known and they were superb horsemen. Rome's decline and fall, for which so many causes have been advanced, can also be imputed in considerable part to horses.

Arabian a late arrival

It is a curious fact that while horses were playing a dominant part in the ancient history of the Mediterranean, the Arabian horse, which was to become the most famous and important in the world, did not yet exist as such. There is no evidence that the Arabs or allied Semitic tribes had any horses before the Christian era, although they already had camels. During the first few centuries after Christ, no one knows exactly when or how, some particularly potent strains of horses were introduced among the Arabs. These animals were for a long time few in number and their possession was confined to a few prominent men or families, but the stock was carefully perpetuated and increased so that by the time of Mohammed the Arabs had acquired great skill as horsemen and also a stock of phenomenally fine horses.

It would be difficult to overemphasize the historical importance of these Arabian horses. During the many long centuries of struggle for dominance in the eastern Mediterranean and western Asia, the Arabs had managed to hold their own in their sandswept deserts, but they had never been a source of danger to the surrounding lands. Thus they might have remained until the end of time except for horses and Mohammed. Mohammed preached the doctrine of Allah and fired the holy war; he also preached horses. "Every grain of barley given to a horse is entered by God in the Register of Good Works," says the Koran to the horseman, and to the horse: "Thy back shall be a seat of honor and thy belly of riches." Mohammed's followers mounted their horses and rode off to conquer the world. The story of that conquest could almost be written in terms of horses rather than of men.

Mohammedan horsemen outclassed

The turning point came on the plains of Poictiers in 732. The Saracens had swept across northern Africa, had conquered Spain, had swarmed over the Pyrenees, reduced Bordeaux to ashes, and ravaged Aquitania. Their horses were galloping onward and European civilization was threatened with extinction. At Poictiers the lithe Moslems on light, swift Arabian and Barbary horses were opposed by the more sturdy Franks, clad in mail, and carried by the great European battle horses. The Saracens could not break the solid front of the heavy horses, their own flank was turned, and the fear of Mohammedan dominance in Europe was at an end.

All during the Middle Ages the European breeders were concentrating largely on producing heavy horses, whether for work or for war, and the light Arabian type was not prized, except for cross-breeding. For this purpose Arabian, Barbary, and other horses of the dark, slender southern races have always been in extreme demand, and the great horses of chivalry had much of this blood, even though they were so unlike this side of their ancestry. In Arabia itself the pure Arabian type is said to have been damaged by attempts to supply an almost unlimited demand for cross-bred horses. Thus the blood has spread over the whole world, and except for specialized breeding purposes, the progeny often excel the pure Arabian animals.

As armor became heavier and more complete, the knights' great horse necessarily became stronger and larger. Toward the end of this evolution, a horse with his own armor, a rider, and the rider's armor and arms was carrying about 500 pounds. Later a revolution in methods of warfare placed a premium on lighter and faster horses again. The cycle in England ran from William the Conqueror to Cromwell. The famous battle in 1066 was itself a testimony to the power of the horse in human affairs, for the Anglo-Saxons, afoot, lost the day to Normans of sturdy horses like those that destroyed the Saracens at Poictiers. At the other end of the long story, Oliver Cromwell mounted his famous Ironsides on light horses such as had already become popular in England through the development of racing and hunting, to the distress of more conservative military authorities, and they roundly defeated their opponents who were mounted on little-altered descendants of the medieval great horses. The heavier horses have, indeed, continued for coaching and draying, but most breeders have long concentrated on types like the strangely mongrel but wholly admirable, curiously named thoroughbred.

The Mongols and their horses

While European horses were plodding through the interminable and relatively petty affairs of the Middle Ages, a horse-borne plague swept over Asia. To the Mongols, horses were not merely badges of rank, implements of war, or sources of diversion and excitement. They were all these and much more. They were such an intimate part of life that life without them was impossible. They were friend, food, drink, buckler, shelter, god, and often life itself. There was no gentleman ahorse and commoner afoot. Everyone had a horse, or if he had not, the first comer would probably give him one. Everyone rode hard almost from the day he was born until he died. Theirs was a true horse culture complex in which the horse was the dominant, the one essential feature. Mare's milk was the common drink and from it was made kumys by light fermentation, and fiery arak, a highly intoxicating liquor. On long marches the soldiers sometimes drank their horse's blood, without killing him. A horse skull was an object of worship in the old shamanistic creed. Horses were exacted as tribute or given as gifts, their numbers sometimes running into the hundreds of thousands. A horse's rights and worth were much on a par with a man's, and it is not surprising to read in the Yassa, the Code of Chingis Khan, that a horse thief must pay back nine animals for every one stolen or failing that must give his children in place of animals, or if he have neither nine animals nor children he shall be slaughtered like a sheep (with very gory details as to the technique of his execution). Such provisions suggest the lynching of horse thieves in our own frontier days, when we also had a horse culture, but one less intense. We also learn (but on less good authority) that forty maidens and forty white horses were slaughtered on the grave of Chingis, and this is at least possible, for among many other horse loving nations horses have been used as sacrifices, and not infrequently humans also on the same basis as the horses. It is noteworthy also that white is often a sacred color for horses. White horses have been much in demand among the Arabs, for instance, even though they believed bay horses to be better in every other respect.

Such are a few of the more obvious and superficial features of an intense horse culture complex. In its deeper aspect it involves an almost mystical kinship of the horse and his rider, and in the case of these men, the Mongols, this cannot be overlooked as an essential element in their amazing achievement. Traveling and fighting on horseback they built the greatest empire the world has ever seen.

The horse comes to America

The closest parallel to such a culture complex based on the horse was developed among the men, both white and red, of the North American plains and South American pampas. It is well known that there were no horses living in America when the Europeans first landed here. On this occasion, as on so many others, horses at least accelerated history if they did not altogether change it. Cortez had only sixteen horses when he landed in Mexico, and probably never had as many as a hundred during the conquest, yet these were such objects of superstitious dread to the Indians and they acted so effectively against the Indian infantry that they did perhaps as much as any other single thing to enable his small band to perform the seeming miracle of conquering the greatest Indian nations.

Spanish horses escaped or were loosed in Mexico, in the Mississippi Valley, and near Buenos Aires, and they thrived so that both continents soon had vast herds of feral horses. The Indians took to horses with a whoop of joy and had soon so completely molded their lives around these animals that they seemed always to have had them. So rapidly did this take place that many tribes had gone over entirely to the horse long before they had ever seen a white man. The tribal distributions, politics, and habits of almost all the plains Indians were profoundly altered by this new acquisition, and incidentally they were changed from relatively feeble and immobile groups into hard-hitting, fast-moving raiders. The white man's animal became the Indian's best ally in his struggle with the whites. As the West was colonized, horses were needed in order to travel, to handle cattle, and eventually to plough up the sod. We hardly need the "horse dramas" of Hollywood to remind us how inextricably the horse is linked with our own history. The blood of the steeds of the conquistadores still flows in the veins of our western ponies, but it has been much modified by crossing with larger animals of more recent importation, and the old mustang is now practically extinct.

Future of the horse

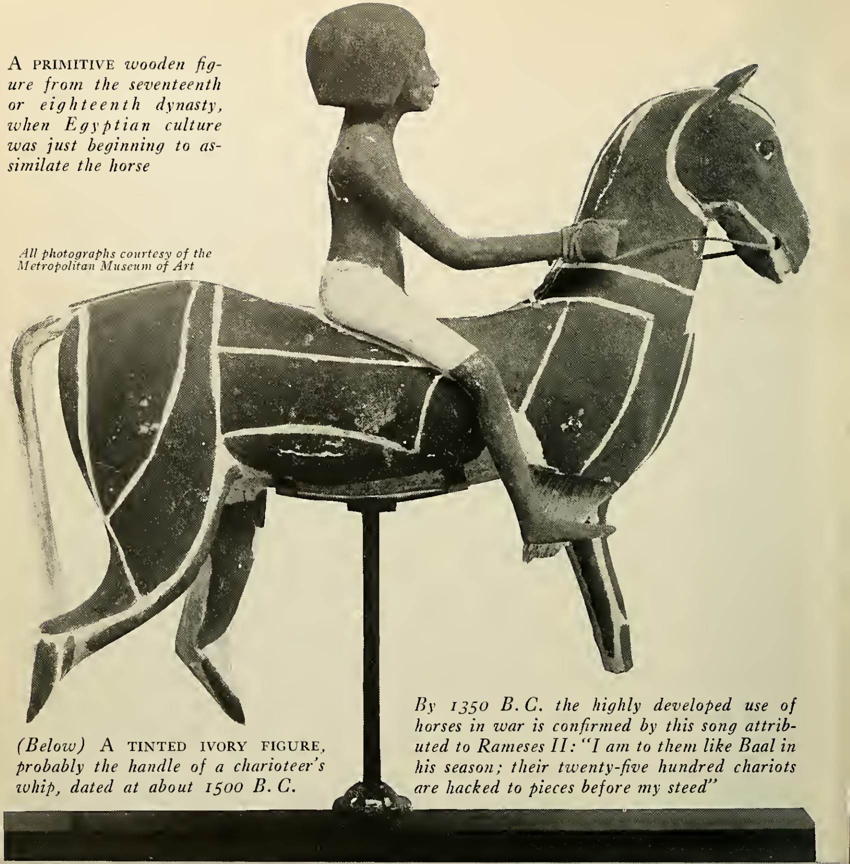
This generation usually assumes that the horse's rôle in history has been played to its end, and that our noble companion will survive only as a curiosity or an amusement. Certainly if the recent tendency toward mechanization continues, the horse can never again be as dominant a factor as in the past. At present, however, this mechanization is less advanced than most are inclined to think. There are still millions of people to whom the horse is the principal or only means of transportation and source of power. Even in our own country there are at present more than 10,000,000 horses on farms. There is no probability that the horse will ever lose his usefulness entirely, and if he did, yet he would still be cherished as a friend and as a source of pleasure. The horse will probably continue to have some share in human history as long as that history is made.

"Yet if man, of all the Creator planned,
His noblest work is reckoned,
Of the works of his hand, by sea or by land,
The horse may at least rank second."
(A. L. Gordon).

"The air and gracefulness of sitting a Horse," says Don Quixote, "makes gentlemen of some and grooms of others." (Right) An illustration by Gustave Doré from "Don Quixote"

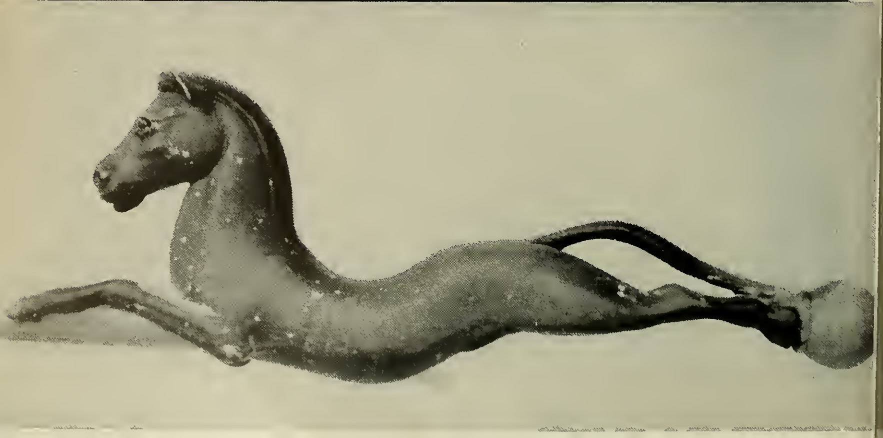
A PRIMITIVE *wooden figure from the seventeenth or eighteenth dynasty, when Egyptian culture was just beginning to assimilate the horse*

All photographs courtesy of the Metropolitan Museum of Art



By 1350 B.C. the highly developed use of horses in war is confirmed by this song attributed to Rameses II: "I am to them like Baal in his season; their twenty-five hundred chariots are hacked to pieces before my steed"

(Below) A TINTED IVORY FIGURE, *probably the handle of a charioteer's whip, dated at about 1500 B. C.*



(Upper left) BAS RELIEF *commemorating the wars of Sargon II, King of Assyria. It was in this region that fourteen centuries previously the tamed horse had first been brought into a civilized community*

(Upper right) ASSYRIAN WARRIORS *in mountain country: relief from the palace of Sennacherib (705-681 B.C.), an even more illustrious conqueror than his father, Sargon II. He utilized horses extensively in his campaigns against Egypt and Babylon*

(Above) HORSEMAN OF MARBLE *(Rhodes). Date: fourth century B.C. Even before the sixth century B.C. the man who could afford to keep a horse as a luxury in peace and to raise him above the ruck of the battlefield of war, had already become an aristocrat*

AN ETRUSCAN BRONZE *showing the horse-drawn chariot used by the Italian civilization which preceded that of the Roman emperors, in whose hands it degenerated into a sporting device*

©B. N. from William Thompson

CONQUEST OF BRITTANY *by Caesar, from a fifteenth century engraving*

(Above) GRAND FANTASIA *in modern Morocco. It was on steeds such as these that the early Arabs spread the religion of Mohammed*

A PERSIAN *version of the sedan chair*

THE HORSE *of the Lamido of Marua Cameroons, West Africa: an interesting example of the native love of adornment*

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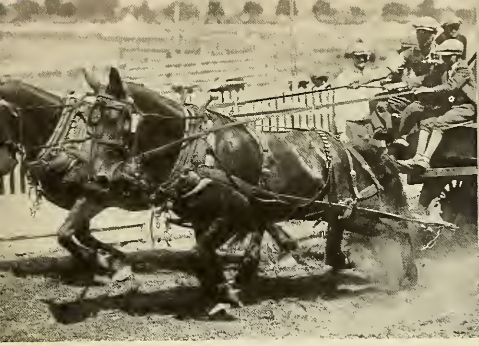
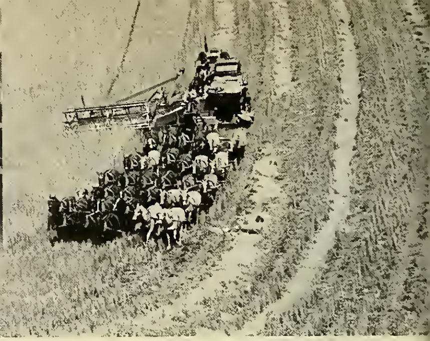
(Upper right) A NATIVE CAVALRYMAN *of Algeria. Even today horses are used extensively in desert warfare*

RUSSIAN COSSACKS *during the Czarist regime, when they were the most feared Asiatic horsemen*

A HORSE *does not have to be a Derby winner to merit the affectionate care of his master*

Globe Photos





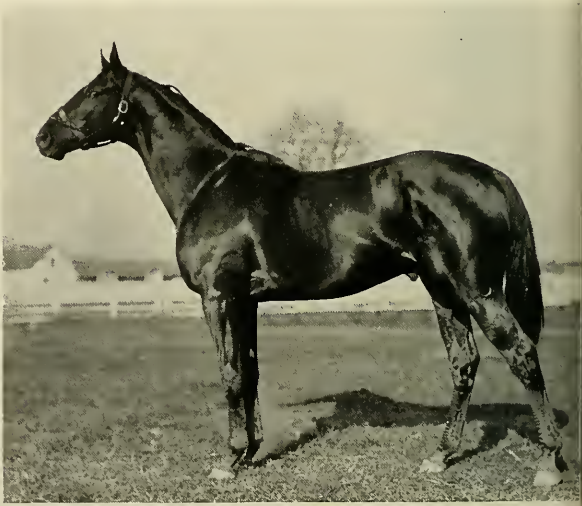
Ewing Galloway

HORSE PULLING CONTEST *at a fair, an excellent portrayal of the muscular equipment of our larger work horses*

THIRTY "HORSEPOWER" REAPER. *Ten million horses are still used on farms in the United States*

MAN-O'-WAR, *one of the greatest race horses of all time. It is probable that the first meeting between two horsemen resulted in a race. The competitive element is universal and will probably be the last to disappear*

Photo by S. H. Chubb



(Below) POLO PONY AND HUNTERS, *two examples of the horse as a modern luxury. The horse will always have a place in man's life as long as there is a bond of mutual affection*

Ewing Galloway

European

H. Armstrong Roberts

"Relief" in the Sub-Arctic

The tragic economic story of the Northern Indians: a thirty-year decline from the freedom of their ancient hunting grounds to a place in the "breadline"

By PHILIP H. GODSELL

[*The author, a veteran fur trader, has spent some thirty years among the aborigines of Northern Canada as an officer of the Hudson's Bay Company, and is the author of the book "Arctic Trader."*

The present article is particularly timely because it follows close upon a report issued by the Department of Indian Affairs at Ottawa stating that a large percentage of the Indian population of Canada is on relief, and because it has a bearing on the widely discussed problems of conservation and social administration.

As an institution for dealing with primitive peoples, the Hudson's Bay Company has perhaps had unparalleled experience, having operated since 1670 on a charter which makes it the oldest existing corporation in the world. The author's familiarity with this organization and with the Indians about whom he writes enables him to present a page from history which contains broad social implications. —The Editors.]

When I stepped ashore some thirty years ago at the palisaded stronghold of York Factory—long the Hudson's Bay Company's capital in the Northwest—to commence my long and lonely years of apprenticeship to the "Gentlemen Adventurers," the vast wilderness extending from Labrador to Alaska, and from the Great Lakes to the Arctic Islands, was one enormous game preserve. Nearly thirty million caribou roamed the Barren Lands. Each spring these animals migrated northward, the females leaving the bulls on the mainland and making their way to the Arctic Islands to have their young. In the autumn they re-joined the bulls on the mainland and then migrated southward in order to reach the protection of the timber ere the winter blizzards lashed the Barrens from end to end with devastating fury. The forests to the southward were filled with moose and deer, while fur-bearing animals of all kinds native to the region were abundant. With their primitive muzzle loaders the Indians were unable to do any great destruction, consequently the foundation stock of the animal life of forest and tundra remained almost unimpaired.

Self-supporting

There were but few destitute Indians and Eskimos in the North in those days, and they were taken care of by the others. The Crees, the Chipewyans, the Ojibways and, in fact, all the Northern tribes still retained their pride of race and were engaged in their ancestral and healthful occupations: hunting, fishing and trapping. They traded their furs at the picketed forts of the Hudson's Bay Company which dotted the land from end to end, nestling like birds' nests beside the lakes and watercourses—the arterial highways of the land. True, the Indians did not receive high prices for their furs, but then their wants were simple, while the Company imported only the best of everything.

While, theoretically, the Hudson's Bay Company had surrendered their monopoly nearly forty years before they were still paramount throughout the greater part of the Canadian North, a factor which made it possible to protect the natives from those unfavorable aspects which were always predominant when there was strong and active competition in the wilds. The Indian was recognized as an economic asset of the first importance since the entire success of the Fur Trade was dependent upon his well-being. Therefore, he was safeguarded and given a measure of protection in times of stress.

There was in effect at this time a profitable and thrifty system of "farming the forests" which had been in effect for centuries. Each Indian family owned their own individual hunting grounds which were handed down from one generation to another. These were distinguished by certain ranges of hills, rivers, creeks and other landmarks which formed the boundaries, and since each hunter's rights were fully recognized there was little or no poaching. Furthermore, this system lent itself admirably to a form of aboriginal game conservation.

Rotation of game

In the "Good Rabbit Years," when the woods were overrun with snowshoe hares, and the lynx and foxes that preyed upon them were plentiful, the beaver were left practically untouched, being permitted to multiply and thus form a reserve which could be drawn upon when other furs became scarce. For the furbearing animals, like the rabbits, multiplied, became inbred, were thinned out by epidemics, and then increased again within regular ten year cycles, only the "overflow" being trapped and disposed of to the fur traders.

But the twentieth century was destined to become an era of unexampled expansion and progress. Civilization and commerce, anxious to open up new lands and fill their coffers, pushed their steel tentacles ever farther and farther into the wilderness. Soon twin ribbons of steel girded the Barren Islands, and from the barren rocks of Fort Churchill there arose, almost overnight, a sub-Arctic port and a two and a half million bushel elevator. Pioneer settlers, misled by extravagant accounts of the fertility of the Peace River country, sold out their homesteads in Wyoming and Texas, threw their goods and chattels into ox-drawn wagons and hit the trail for the beckoning North. Soon the Cree and half-breed trappers of the "New Northwest" gazed with undisguised amazement and alarm at the ever-swelling stream of sleighs and covered wagons treking unceasingly up from the southward and disappearing into the heart of their ancestral hunting grounds.

But the death-knell to the free and untrammeled life of the Northern Indians was sounded when, shortly after the War, a pioneer railroad penetrated into the heart of the Peace River country, while another tapped the vast two thousand mile network of rivers extending from Fort McMurray to the very rim of the Polar Sea; the mighty Athabasca-Mackenzie system. This furnished opportunities which the acquisitive palefaces were not disposed to overlook. Soon the picketed log trading posts of a million dollar American concern—the Lamson and Hubbard Company—stood cheek by jowl with those of the Hudson's Bay Company throughout the land. Then, like a rolling tide, a motley horde of adventurers, white trappers and "free traders" swept Northward, spread out fanwise and worked their way up all the large rivers, streams and tributaries of the land. Leaving the end of steel in their scows and flat-boats they floated down the Athabasca, the Slave and the Mackenzie rivers, carrying to the natives the "blessings" of civilization in the form of alcoholic extracts and the ingredients for home-brew; jazz garters, silk dresses and French-heeled shoes for the dusky ladies of the wigwams, together with high-powered rifles and unlimited supplies of ammunition to enable the hunters to raise havoc with the remaining game herds.

A fool's paradise

The Indians were delighted. The war-time boom in furs was at its height, while the keen competition that ensued between contending traders forced fur prices far beyond those of the leading markets of the world. Spurred on by the desire to possess the gaudy luxuries displayed so tauntingly on the shelves of the trading stores the red men trapped as they had never trapped before, and there ensued an undignified and uneconomic scramble. Within three years the Indians had become thoroughly demoralized, their dependability destroyed, and their original honesty completely and effectively eradicated.

The Slavey, Yellow Knife and Dog-Rib tribes who inhabit this region had never borne the paleface much love, and when the Lamson and Hubbard Company brought a large number of white trappers in from the United States and elsewhere, grubstaked them and scattered them throughout the country they looked on with bitter anger and resentment. For, unlike the Indian, the professional white trapper is out to make a clean-up in the shortest possible space of time. In the autumn he proceeds to build cabins every twenty miles or so along his trapline, then from the first snowfall until the ice breaks up in the spring he is tirelessly on the go, and in the course of a single season will accumulate three or four times as much fur as an entire Indian family would over a period of years.

Poison bait

Anxious to amass riches by the quickest and most effective means these newcomers resorted to a more efficacious and deadly manner of acquiring furs than by the use of the steel trap and the deadfall. Promiscuously, and with lavish hand, they scattered poison baits along the hunting trails of the redskins, destroying many of the Indians' sleigh dogs and laying waste large areas of territory. For the use of poison was infinitely more destructive than the most intensive trapping could ever be. Animals swallowing these baits would frequently live long enough to escape deep into the woods and die, to be devoured by other forest dwellers whose polluted carcasses would destroy still others, and so it went. As soon as one section of the country had been denuded of fur-bearing animals the trapper would pile his belongings into his canoe after break-up and look for new pastures where the process would be repeated.

When the Indians saw these strange palefaces taking casual possession of their hunting grounds, saw their dogs poisoned and their traplines dotted with the usurpers' traps and poison baits, they were consumed with overwhelming anger. They trapped intensively to prevent these hated "Long Knives" from getting too many furs, burned their cabins, and deliberately set forest fires to drive out the invaders. Consequently many thousands of square miles of forested country were burned over with an appalling loss of animal life; a drop in the water level ensued, drying up large areas of marshland which had been the breeding grounds for millions of muskrats, and those posts which, a few years ago, shipped out thousands of these small pelts to be converted into Hudson Seal found their shipments reduced to mere hundreds.

Then came the airplane which made these erstwhile natural game and fur preserves more accessible and vulnerable than ever. Nowadays trappers can hire an airplane to take them into new and previously inaccessible hunting grounds which would have entailed months, and even years of travel, in the old days. They can scout new territory from the air, and in the course of a few hours range over a wide area to select their winter trapping grounds. At least one trapper owns an airplane of his own, which enables him to cover a vast extent of territory, and renders him almost immune from Game Guardians, Game Laws, Mounted Police and State boundaries.

Airplane companies have grub-staked trappers, transported them into the hearts of the Indian hunting grounds, with adequate supplies of traps and other equipment, picking them up at the end of the season and allowing them twenty-five per cent on the gross value of their fur catch.

Consequently the Indian is entirely at the mercy of the trapper and the hunter, with little or no voice in his own protection and defense since he signed away all rights to the land the moment he placed his mark upon the Treaty made with the representatives of the Great Father.

The wilderness he once owned is being exploited as never before, and he, along with his ancient enemy—the Eskimo, is in a fair way, ere long, to become an even greater charge than he is at present upon the Dominion Government.

A race without a country

Some of the Western tribes, especially the Blackfeet, have been converted into more or less capable and successful farmers. But the Northern Indian is at the cross-roads. He is neither physically nor mentally adapted to compete with the white man either as a laborer, or in mining and industrial pursuits. His is not a farming country, but a wilderness of forest, rock and muskeg. He is, and will remain, in spite of all the education he might receive, essentially a hunter and a trapper, and if the game is not safeguarded he will either disappear as the Beaver and Sickannie Indians of the Peace River are doing, or will develop into a permanently dispirited

(Continued on page 358)

The Meteor Craters in Estonia

"Footprints" left by visitors from outer space—Evidence of an astronomical collision that occurred perhaps two thousand years ago

By CLYDE FISHER

Curator of Astronomy and the Hayden Planetarium, American Museum of Natural History

"THE most interesting spot on Earth" is the designation said to have been given by the great Swedish scientist, Arrhenius, to Meteor Crater in Arizona. Little did he suspect the existence of a whole group of such craters at his own back-doorstep, as it were. Meteor craters constitute the visible effects, the footprints,—one may say,—of the only visitors from outer space that actually reach the Earth. Well may they engross the attention of geologists and astronomers.

Recently recognized

In Estonia, which before the days of Peter the Great belonged to Sweden, is located this group of a half-dozen such craters. Although of prehistoric origin, their true nature was not recognized until 1927.

Upon joining the Harvard-M.I.T. Eclipse Expedition, whose work in connection with the total eclipse of the sun on June 19, 1936, was mentioned in the October issue of NATURAL HISTORY, it was my fond hope before returning to America to fly over the famous meteor craters near the Stony Tunguska River in north-central Siberia. To my great disappointment, I was advised by the Soviet Academy of Sciences, and I believe with good reason, that it would be impracticable to do this in mid-summer. Consequently, I turned my attention immediately to the Estonian Craters, which I had all along hoped to examine on my way back from the eclipse belt in the U.S.S.R.

Leaving Leningrad on the evening of June 27th by rail, I was in Tallinn, the Estonian capital, early the next morning. This old Baltic city, founded more than 700 years ago by King Waldemar the Second, of the Danes, has miraculously preserved its medieval character. Apparently it has not suffered the ravages of war, although in one of the many towers of the old city-wall, namely, *Kiek-in-de-kök,* a number of large cannonballs may still be seen embedded in the masonry. The Old Town with its very narrow, crooked streets, flanked with high-gabled stone houses, its old ramparts and battlements still largely intact, the massive wooden doors, often carved, and in remarkably good condition,—is altogether a fascinating place. The old moats, however, have been filled and converted into fine promenades and paths which girdle the Old Town with a beautiful belt of green.

At the suggestion of Professor E. Opik, Director of the Tartu (Dorpat) Observatory (Estonia), I called at the office of Mr. Ivan Reinvald, Mining Engineer, Inspector of the Mining Industry of Estonia, who had explored the craters that I wished to visit, and who had been the first to conceive and announce to the scientific world the correct theory of their origin.

Location

Very soon I was able to arrange a visit to the craters, which are located on the Island of Saaremaa (Oesel) in the Baltic a little way west of the main coast of Estonia. The quickest way to make the trip from Tallinn to Kuressaare (Arensburg), the capital of the Island of Saaremaa, near which the craters are located, is by autobus, with a small steam-boat to carry one from the mainland of Estonia out to the Island of Saaremaa. It was my good fortune to spend two days at the craters, and one of these days was with Reinvald, who has studied them so thoroughly.

In picturesque surroundings

Kuressaare, or Arensburg, as it was known to the German Knights, is a quaint old town with a castle 700 years old. I think I have never seen such narrow sidewalks, many of them only about a foot wide, and some even narrower. In the evening it is interesting to see the cows on returning from pasture adopt these narrow sidewalks in preference to the cobble-stone streets. On driving from Kuressaare out to the craters about a dozen miles to the northeast, one passes through a level and fertile farming region with here and there a patch of forest trees remaining. As evidence of good farming, fine fields of wheat, rye, and clover and smaller patches of potatoes lined the roadsides. (We were told that Estonian vodka is made of potatoes, while in Russia it is made of rye or wheat.) Around the craters the peasants were making hay, this activity being at its height. Although a little late in the season, at the time of my visits (June 30 and July 4, 1936) the skylarks were still singing their ecstatic flight-songs over the peasants' fields surrounding the craters.

The main crater contains a beautiful, circular lake, which has long been known as Kaali Järv, meaning Kaali Lake. In fact, the name "Kaali" has come to be used for the whole group of craters of which there are six of undoubted meteoric origin. The diameter of the lake in the main crater is nearly 200 feet, while the diameter of the crater from rim to rim averages more than 300 feet. The crater rim or wall rises 20 to 25 feet above the level of the surrounding ground. The crater is bowl-shaped and quite symmetrical, the rim or wall being steeper on the inner slope than on the outer. The rim is well wooded with large forest trees consisting of elm, ash, maple, spruce and oak. I noted no pine or white birch, although both are common on the island. There are present many hazel-bushes, which are sometimes small trees, and a shrubby dogwood. On top of the rim is a shady trail extending clear around the lake, a circular "lovers' lane," evidently much trodden. On one side of the lake (Kaali Järv) is a stone table used as a place to drink coffee by Baron von Moller, former owner of the Kaali estate on which the craters are located. The ground around the craters is level farming land which has been cultivated from time immemorial, no doubt for hundreds of years. The nearby town of Kuressaare is more than 700 years old.

One's attention is immediately attracted to the broken edges of the dolomite strata which jut out all around from the upper part of the interior wall of the crater, and to the fact *that these huge fragments are tilted upward* from the inside 30 to 40 degrees,—reminding one of similar conditions in Meteor Crater in Arizona. These tilted dolomitic strata are together about 25 feet thick, and they belong, geologically speaking, to the Upper Gottland (Silurian), which underlies the thin glacial drift in this whole surrounding region, and which is practically level where undisturbed.

Rock-flour

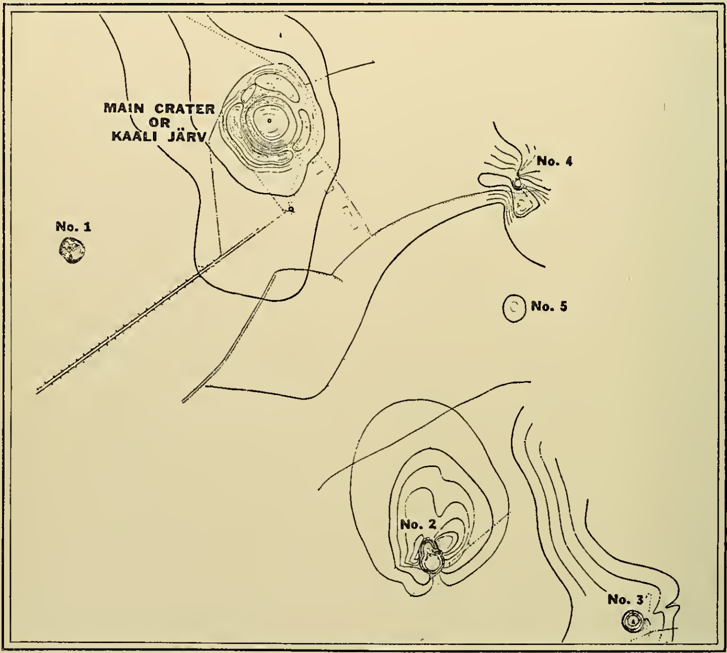
Beneath these tilted dolomites, Reinvald showed me a belt of white or slightly brownish powder containing soft pieces of whitish rock, which could easily be ground to powder between the fingers. Chemical investigation had shown that both the powder and the rock fragments were similar in composition to the surrounding dolomite strata. A bore-hole sunk by Reinvald showed that this girdle of powder is nearly 20 feet thick, and that it lies between the tilted fragments above and the undisturbed horizontally lying dolomites beneath. Evidently it constitutes a most striking analog of the rock-flour ("star-dust") at Meteor Crater in Arizona, the latter being Coconino sandstone which was crushed and pulverized by the impact.

Careful measurements of the lake-bottom were made on six radii, at every two metres, down to the soft muddy bottom,—the water being 25 or 30 feet deep, varying with the season. The soft, muddy bottom of the crater is therefore nearly 50 feet lower than the upper rim. Measurements were made on four radii, not only down to the muddy sediment, but also to the solid bottom beneath it. This investigation showed the muddy bottom to be nearly flat, while a funnel-shaped depression with a prolonged form was discovered in the hard bottom beneath.

The main part of this exploratory work was done by Reinvald in the autumn of 1927 by the order of the Mining Department of the Ministry of Trade and Industry of Estonia. In this work a bore-hole was put down at the base of the crater-wall on the outside to a depth of 207 feet, and two smaller boreholes were sunk in the inside wall.

Besides the main crater (Kaali Järv), there are five smaller depressions, undoubtedly of the same origin, scattered around it on an area of about one-third of a square-mile. The rims of the small craters, instead of being forested by large trees, are for the most part overgrown by hazel-bushes which in some cases cover the crater-bottoms as well. These craters vary in size from about 35 feet to about 130 feet in diameter. Their dimensions and characteristics are given in connection with the accompanying figure.

It is to be noted that Crater No. 2, unlike



Where Meteors Struck the Earth

The above map, embracing an area approximately a half mile square, shows the relative positions of the six meteor craters in Estonia discussed in the present article

Details

Crater No. 1: *360 yards southwest of the main crater, and similar in shape; diameter, 120 feet; depth, slightly over 13 feet; tilted dolomitic blocks near the rim as in the main crater, overlying a girdle of powder.*

Crater No. 2: *930 yards south of main crater; oval in shape, about 175 feet by 120 feet; depth, nearly 12 feet.*

Crater No. 3: *275 yards east of No. 2; characteristic bowl-shape; more than 100 feet in diameter and nearly 12 feet deep.*

Crater No. 4: *275 yards east of main crater; characteristic bowl-shape; diameter, 65 feet; depth from 2 to 4 feet; rim formation similar to main crater.*

Crater No. 5: *185 yards south-southwest of No. 4; diameter, about 35 feet.*

the others, is oval. This fact Reinvald interprets as indicating that the crater was probably formed by two meteorites falling close together—a likely theory which can pretty surely be determined by careful excavation.

Effect of impact

Most illuminating in connection with Crater No. 4 is the condition of the central portion of the bottom. Though the feature has not yet been seen in any of the other craters, this is probably because they have not yet been excavated. The entire bottom, except for a small area in the center, is composed of fresh, hard dolomite in its original, undisturbed strata. But the central portion about 18 feet in diameter is a shallow depression about 16 inches deep, in the center of which is a blind funnel about three feet long by a foot and a half broad, and a foot and a half deep. This funnel is certainly the result of impact. By the curve in the thin marly streaks in the dolomite at the margin of the funnel (streaks which are horizontal in the unchanged dolomite), evidence can plainly be seen of the downward pressure of the meteorite at the time of impact. The 18-foot depression is surrounded by a zigzag broken rim, and the dolomite here is not fresh and hard, but is slightly deformed; it is cracked, slightly wavy, swollen, and has a burnt appearance. It is lighter in color than the fresh surrounding dolomite, is soft and easily cut by the shovel. From the streaks of marl and other characters, it is clear that this changed dolomite is still in situ. The burnt and somewhat shattered dolomite around the funnel, which was found by bore-holes to extend downward some 15 feet below the top of the funnel, is no doubt the result of heat developed by the impact of the meteorite.

A peculiar condition of the burnt dolomite is to be noted here, namely, it has been more affected by heat below the surface than at the level of the top of the funnel. In other words, there is a thin layer, or "skin," of comparatively fresh dolomite around the funnel covering the burnt dolomite beneath, indicating that the heat was radiated from the interior of the funnel, as one should expect.

This burnt dolomite constitutes an interesting analog of the fused quartz or Le Chatelierite at Meteor Crater in Arizona.

The main part of the crater with its elevated rim is undoubtedly the result of explosion, primarily from the sudden transformation of ground water, as well as the moisture in the dolomite, into steam, when the energy of the onward motion of the meteorite was instantly changed into heat. As stated by Reinvald, the size of the crater indicates the extent of the explosion, but the meteorite itself was of insignificant size in comparison with the dimensions of the crater. It is certain that the conditions were essentially the same in the formation of all the craters of this group.

Reinvald is planning to excavate Crater No. 5 next, although further evidence is not necessary to convince one that the craters were formed by the fall of meteorites, principally by the attendant steam explosion. This theory of origin was first conceived and stated in 1927 by Reinvald, and he has since found convincing evidence.

Meteoric fragments are lacking

It is true that no meteoric material has been found in or around the Estonian craters. If the meteorites which caused these craters were *iron,* as Reinvald judges on account of the strength and acuteness of their action, the pieces were probably carried away by the peasants, or by the earlier Vikings. Iron was prized by the Vikings; and it is known that the Danes, who were the founders of this Baltic province, had no iron in their home country. In support of this theory, it is also known that the Eskimos pounded off with tough rocks fragments of the Cape York meteorites, which Peary brought from Greenland, for the purpose of making knives. The Eskimos also used a small specimen of iron meteorite weighing between 3 and 4 pounds as a hammer. The latter specimen, which was found in Ellesmereland, was presented to the American Museum by Dr. W. Elmer Ekblaw of the Crocker Land Expedition. Here it may be seen together with the Peary meteorites from the same general region.

How quickly the meteoric iron has disappeared from Meteor Crater in Arizona and from the Henbury Craters in Australia with the influx of people! We have seen the meteoric iron disappear in the former case in less than 50 years. While it is true that thousands of pieces have been picked up around the Arizona crater, it is now seldom that a piece is found even on this semi-desert. The Kaali Craters in Estonia are located in arable land that has been tilled for hundreds of years, thus providing ample time for the iron to be carried away. And then some forms of meteoric iron oxidize and disintegrate very rapidly. The absence of meteoric iron about the Kaali Craters does not prove that it has never been there.

After the explosion, the mass of the meteorite in all probability lay in the form of débris around the crater and partly in the mass falling back into the crater. Reinvald maintains that it is absolutely futile to search for the "main mass" of the meteorite in the crater itself, even if pieces should be found lying around.

As Reinvald points out, the group of Kaali (Estonian) Craters bear surprising resemblances to the Henbury Craters: (1) the craters have the same charactertistic bowl-like form, besides the presence of an oval crater in each group, namely, Crater No. 2 at Kaali, and the "main crater" at Henbury; (2) the craters are approximately the same size,—12 to 120 yards at Kaali, 10 to 120 yards at Henbury; (3) in both groups the rims of the craters are partly formed by upward tilted blocks of the upper layers of the country rock; (4) there are signs of high temperature in both groups,—at Kaali, burnt dolomite,—at Henbury, pieces of fused sandstone; (5) in both groups there is found a fine powder mixed with coarser fragments of the country rock. The origin of the Henbury Craters, however, has been confirmed by the additional evidence of the presence in the immediate vicinity of numerous pieces of meteoric iron, some 25 or 30 pieces of which are in the American Museum collection of meteorites.

A fairly recent occurrence

The age of the Kaali Craters is young geologically. From the mixture of glacial drift and crushed dolomite in the material that fell back into the craters after the explosion, and from the fact that the elevated rims have not been disturbed, it is evident that they were surely formed after the last retreat of the continental glacier. The large forest trees inside the main crater and on top of the rim certainly put the date of origin back a few hundred years. Considering all the evidence, it seems that the age of the craters may be as great as two thousand years.

Bearing also on the question of age, is the finding in Crater No. 4, of fragments of shells of land-snails of species that live today on the bushes in the vicinity. These broken shells were located in pockets, covered with the glacial drift and crushed dolomite, which fell back at the time of the explosion, and they remind one of the finding of shells of water-snails of recent species in the lacustrine deposits in the bottom of Meteor Crater in Arizona.

Not only did I have the opportunity of seeing practically all of this absorbing evidence under the direction of Reinvald, but I have also drawn heavily on his papers* in writing this account.

Specimens

I have brought back with me a complete series of specimens illustrating the phenomena described above, which were collected in my presence by Reinvald and presented by him to the American Museum of Natural History. These will be added to the Museum collection of meteorites now installed in the Hayden Planetarium building.

Not only am I personally grateful to him for his unfailing courtesy, but I wish also to recognize the debt which science owes to this well-trained and cautious worker for pursuing his research with such devotion. The Ministry of Trade and Industry has not been interested to invest money in the research since the initial exploration in 1927, because there was no hope of economic returns. Engineer Reinvald has therefore carried on his careful investigation of Crater No. 4, which has yielded such unique and important results, at his own personal expense, without the hope of pecuniary reward. He has added much to our knowledge of this fascinating type of nature's phenomena.

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*"Bericht über geologische Untersuchungen am Kaalijärv (Krater von Sall) auf Osel," von I. Reinvaldt. Publications of the Geological Institution of the University of Tartu, No. 11, 1928.

"Kaali Järv—The Meteorite Craters on the Island of Osel (Estonia)," by J. A. Reinvaldt. Publications of the Geological Institution of the University of Tartu, 1933.

The Meteor Craters in Estonia

Photographs of scars left on the landscape when a cluster of meteoric fragments struck the earth

By Clyde Fisher

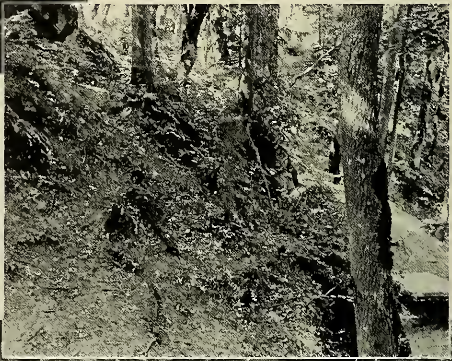
Kaali järv or main crater: *View from peasant's clover-field showing nearly all of the largest crater of the group, overgrown with trees and shrubs—from the outside resembling a bit of virgin forest. One would hardly suspect the presence within of a meteor crater*

(Above) The main crater *as seen from the inner slope of the rim, showing the circular lake* (järv). *The forest trees grow down to the edge of the water*

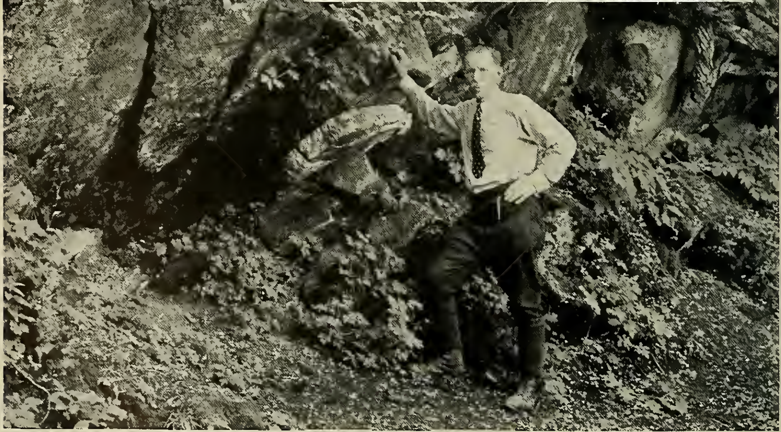
(Below) Another view of the circular lake (Kaali Järv) *which is nearly two hundred feet in diameter*

(Left) "LOVER'S LANE": *Shady foot-path extending clear around the top of the circular rim of the Main Crater* (Kaali Järv), *a favorite visiting-place for the peasants on Sundays and holidays*

(Below) INNER SLOPE OF RIM *of the Main Crater* (Kaali Järv) *the top of which is about 25 feet higher than the surrounding fields, and nearly 50 above the central lake. This rim is composed of a mixture of glacial drift and debris of the bed-rock*



(Below) TILTED DOLOMITE STRATA *which jut out from the upper part of the interior wall of the Main Crater* (Kaali Järv). *Engineer I. Reinvald, Inspector of Mines for Estonia in the foreground*



(Right) CRATER NUMBER TWO: *One of the smaller of the six meteor craters, overgrown with trees and shrubs, and like the others surrounded by level farming land*

(Below) CRATER NUMBER TWO: *Engineer Reinvald standing on the floor of Crater No. Two. On the slope at the left of the picture may be seen his excavations*

(Below) THE FOOT-PRINT OF A METEORITE: *Bottom of Crater No. Four, showing funnel of impact of meteorite, which so far appears to be the only one explored in the world*

Stardust

November's celestial "fireworks"—The Leonid showers, an annual bombardment from outer space which would demolish our cities if it were not for the protection of the atmosphere

By HUBERT J. BERNHARD

PRESENT hopes for communicating with other planets in the solar system are slim—but we are constantly receiving solid messengers from outer space.

On certain November mornings thousands of them—in the form of shooting stars—shower down into the earth's atmosphere. They are part of a large group of meteors traveling together in space, and as the earth, speeding at eighteen miles a second, shoots into the region they occupy, it attracts to itself many of the smaller bodies.

Pulled out of their accustomed paths by the earth's gravitation, they hurtle downward at speeds varying from seven to forty-four miles a second. They are chunks of iron or stone, ranging in size from a grain of sand to a large house, and they are cold with the absolute cold of outer space.

Become white hot

Then, suddenly, they come into the earth's atmosphere and their whole nature changes. As they rush through the thin upper air, their surfaces become warmed by friction. Quickly the warmth increases until the meteors are raised to red heat, then to white heat. They burn with a white glare and give off gases. Part of each one, unburnable, floats softly to the ground in the form of a fine ash.

By the time they have come within fifty miles of the earth's surface all but a few have vanished. They have burned themselves out in their mad, aimless dash through the air.

And the Leonid meteor shower is over for another year.

About 20,000,000 meteors, similar to these Leonids, hit the earth's atmosphere each day in a ceaseless and aimless bombardment from the depths of the universe. Few are visible, for they fall during the day, and in isolated places where there is no one to see them. But the careful observer, who sees only five an hour on average nights, occasionally enjoys a superb treat.

A quarter-million shooting stars

Little more than a hundred years ago, in November, 1833, the same group of Leonid meteors that still visits the earth appeared in the most awesome sky phenomenon yet recorded. At one station alone a quarter-million of these shooting stars were seen to dash to destruction between midnight and dawn.

Such spectacular displays are found to return at more or less regular intervals, and that of 1833 reappears three times a century. Never have the meteors streaked through the night sky in such numbers as they did a hundred years ago, but always they return.

The great shower of 1833 was not the first of the series known as the Leonids. Historical research shows that this group of meteors has been returning to the earth for at least 1300 years. The earliest account of them is the following, from an Arabian writer:

"In the year 599, on the last day of Moharren, stars shot hither and thither, and flew against each other like a swarm of locusts; people were thrown into consternation and made supplication to the Most High; there was never the like seen except on the coming of the messenger of God; on whom be benediction and peace."

The first well-described shower of this group occurred on November 12, 1799, and it was seen by Von Humboldt, a well known scientist and traveler who was then in the Andes. For four hours, he said, thousands of bolides and shooting stars were seen to dart across the eastern sky from north to south. There was no spot in the sky as wide as three full moons that was not full of them. They all dragged trains eight or ten degrees long, which lasted seven or eight seconds. Some looked as big as Jupiter, some showered sparks, some burst. Some, as big to the eye as the moon or half again as big, vanished without sparks but had trains half or two-thirds the apparent width of the moon.

Astronomers noted, during the 1833 appearance, what Von Humboldt apparently missed in the earlier show; that the meteors appeared to be emanating from the constellation of Leo. It so happened that if the paths of the meteors were marked on a star map and traced backward, one would find that they all crossed in that constellation.

From the "vanishing point"

This really is due to the same familiar perspective effect that makes railroad tracks appear to come together in the distance. Those lines are parallel, and geometry tells us that parallel lines meet at a point in infinity; artists call it the vanishing point. The meteors of any particular shower travel through the air in parallel lines, and as these lines seem to come toward the observer, he gets the same converging effect that he would if he were to stand between a set of railroad tracks.

The spot in the heavens at which these lines appear to cross is called the radiant of the meteor swarm and the shower usually takes its name from the star group in or near which the radiant lies.

When this convergent effect had been noted in the 1833 shower, astronomers studied records of the display in 1799 and decided that both showers were related. They predicted another for 1867, a shower that actually fell a year earlier.

The discovery that these great meteoric displays were part of a series led to the deduction that minor displays seen at other times were parts of other, less spectacular, series. Such is the case, and today we find available a list of fifteen more or less well-defined showers which recur annually. Although the big shower of Leonids is seen only twice in a normal lifetime, there is a very much smaller display at the same time every year.

Investigation shows that these meteor swarms travel along orbits that are identical with the orbits of different comets. For instance, the orbit of the Lyrid meteors is the same as that for the comet of 1861, and a meteor swarm appeared to replace the famous Biela's comet. The Leonids, it is believed, came from Tempel's Comet. A list has been prepared to show seventy-six meteor streams whose orbits agree fairly well with the orbits of an equal number of comets.

While some of these comets are still in existence, many of them are extinct, and this fact gives rise to the thought that, as one astronomer put it, "Our periodic meteors may be the débris of ancient but now disintegrated comets whose material has become distributed around their orbits."

It appears likely that this is the case. These meteor swarms are distributed about the orbits in a peculiar manner. There is a main group consisting of millions of meteors bunched together in a loosely connected mass, and all along the orbit are other meteors, distributed in a long stream that usually covers the entire path. It is when the earth cuts the main swarm that we have such a display as the Leonids of 1833, and it is when the earth cuts some other part of the orbit that we have the minor displays seen in "off" years.

When they are in their normal state, out in space, meteors are not visible to terrestrial observers. They can be seen for only a brief moment, in their hour of doom, when they race through the atmosphere leaving glowing gases and ash in their wake. Often meteors have trains behind them which last from one second or less in most cases to the exceptional instances when they are visible for hours.

Some spectacular meteors

In their brilliant flight these shooting stars are sometimes very startling. In December, 1876, a blazing ball of fire swept across the United States from Kansas to Pennsylvania, being sighted at eleven different stations. There are records buried in dusty files that tell of exploding meteors—fire-balls—which arrived during the night and burst with such an explosion that they awoke entire cities.

Sometimes they come during the day, and are so bright that they may be seen despite the sun. One, years ago, burst over Madrid, Spain, with such a noise that the crack of its explosion broke windowpanes in houses.

Two years ago airmail pilot Bill Coyle, of the Transcontinental and Western Air Lines, watched a brilliant meteor "big as the Wichita hangar" flash across the sky and leave a train that endured until daylight.

He was cruising about two miles above the town of Adrian, Texas, when he was surprised by what he at first thought was a giant floodlight turned on in the sky. It was a great meteor, coming out of the northeast and traveling west by southwest.

"In a second or two," Coyle said, describing the incident, "it became too bright for me. We were at about the same altitude. In a moment I caught sight of its tail and could tell it was going north of me. Its line of flight was probably forty or fifty miles distant; at any rate it was so close I could see fragments of the meteor whirling away from it and dropping back into the tail. It left a deep red trail with a bluish tint which hung in the sky until daylight."

This particular meteor disappeared in a thunder-like rumble that shook the ground in several states.

Visible over wide area

It seared the skies of northern Texas, New Mexico, and the Oklahoma panhandle, streaked over Colorado Springs, and was seen by residents of southwest Kansas.

Nor was Coyle's experience the only one of its kind on record. Even more recently another airplane pilot described a meteor which passed within fifty miles of him, and several spectacular ones have been seen from the ground.

When we consider that the effect of friction upon a meteor moving at the comparatively slow speed of one mile per second is the same as if it were standing still in a bath of red hot air, it is small wonder that the life of a shooting star is short. For the average meteor moves at a speed of from seven to forty-four miles a second when it is in the atmosphere, and the effect of the friction at this speed is to raise the meteor's temperature to one thousand times red heat.

This, then, explains why the average meteor is seen for only one second, appearing at a height of seventy-five miles and vanishing at fifty miles. Sometimes, however, they are so big that they are not completely consumed in their flight through the air, and they reach the ground.

Since the area of the earth that is inhabited by man is comparatively small, meteors usually fall in the vast expanses of the oceans or in unhabited desert regions. There is no authentic record of one ever having hit and killed a human being, although one fell in Siberia in 1908, wiping out an entire herd of reindeer and laying waste fifty miles of forest.

Atmosphere protects cities

If the protection that the atmosphere affords from meteors were to be removed, millions of meteors falling each day would crash down on cities and hamlets; they would smash the majestic skyscrapers of New York into a smoldering pile of torn and twisted brick and steel.

This fact was called to the attention of New Yorkers in screaming headlines on the morning of March 14th when a brilliant fireball roared across the heavens from the southwest and vanished above the waters of the Atlantic Ocean. The sudden sight of the phenomenon so impressed editors in the slumbering city that one tabloid newspaper issued an inky Extra, and another paper stopped its presses for the story.

It is believed that the meteor first burst into sight not far from over Norristown, Pa., between 2:47 and 2:48 a. m. Traveling in a general easterly direction, it shot over part of Pennsylvania, cut across the middle of New Jersey, and disappeared off Sandy Hook. The distinct crack of an explosion was heard in Trenton, N. J., causing windowpanes in that city to crack in some instances and giving rise to a wild report that a nearby ammunition dump had exploded.

Far from the line of flight, the meteor was marked by a peculiar flash of bluish-green light, which lasted for an appreciable length of time. The writer, who was indoors at the moment, had his attention called to the "flash of lightning" by a companion, and although he had to turn about to look through a window the light still lingered in the sky.

Eight startled passengers in a northbound airliner soaring through the night over Virginia saw the strange light and watched the yellowish-red mass hiss through the air far ahead. Even as the co-pilot radioed a query to his home office, the fireball was sighted by several ships at sea. At Newark airport, central air terminal of the east, the flash of the meteor was so brilliant that it outshone the floodlights on the landing field.

Reports received at the Flower Observatory in Upper Darby, Pa., show that the meteor was sighted from at least six states and the District of Columbia. Approximately 200 persons recorded the phenomenon, and the states represented were, in order: Virginia, Maryland, Delaware, Pennsylvania, New Jersey, and New York.

Dr. Charles P. Olivier, director of the Flower Observatory and a well-known authority on meteors, reports several competent witnesses as saying that, during the latter part of its path, the meteor itself was brighter than the full moon. Although there is no reasonable way of giving the mass of the meteor with exactness, Dr. Olivier ventures a *guess,* based on the phenomena of sound as well as the object's brightness, that it was at least 50 pounds in weight. It is possible that it may have been several times as heavy as this, but it is most unlikely that it weighed a ton, even as it entered the atmosphere.

Some reports received at the observatory stated that the meteor was seen actually to fall in the water. However, it did not remain brilliant to distant observers until it actually hit, as might have been expected. Its "disappearing point" therefore was some miles high, and the exact figure remains to be computed.

Heat superficial

Those meteors that do land reveal several inconsistent characteristics. After their violent flight through the air, it is only natural to expect that they would be at least red hot when they land, but this is not so. On one occasion a meteor, seen to land on a pile of straw, was picked up a few minutes later and found to be cold to the touch. It had hardly crushed the straw upon which it rested.

Although such a happening as this may seem impossible, the explanation is fairly simple. The meteor's temperature as it hurtles through the air is extremely high, as we have seen, but when it is free in outer space the stone is unbelievably cold—probably close to the absolute zero of -273° C.

The heating effect of the atmosphere is limited to the object's surface, which burns and floats away as ash while the newly revealed surface is heated in turn. The interior of the meteor remains at its original low temperature, and only a very narrow layer of the surface is heated. Thus, when it lands, the stone can cool very quickly.

Some meteors bury themselves far below the surface of the earth, while others simply drop on the ground. One meteor, weighing 647 pounds, fell in Hungary, and ploughed into the earth to a depth of eleven feet. On the other hand, Peary's 36½-ton Cape York meteorite, now housed in the Hayden Planetarium, was found only partly buried. The deeply pitted 15½-ton Willamette meteorite, also in the Planetarium, and the 20-ton Bacubirito stone were not deeply buried, but a 437-pound fragment fell in Iowa and dug eight feet into stiff clay.

Possible origin

In experimenting with meteorites, scientists have found further proof of their contention that these stones are the remains of comets. By placing specimens in a vacuum, heating them, and comparing their light with that of comets by means of a spectroscope, it becomes apparent that the spectra of meteors and comets are similar.

But a still more interesting series of experiments upon meteorites was made by Dr. Charles P. Lipman, of the University of California. After taking extreme care in sterilizing his instruments, Doctor Lipman obtained results which he believes prove that some meteors actually carry in their interiors spore forms of certain bacteria. He has isolated specimens which seem to be in an early stage of evolution similar to that through which some of the common bacteria of the earth passed millions of years ago.

If the discoveries of other biologists should prove Doctor Lipman's theory correct, this obscure experiment may prove one of the most significant findings in modern science, for it may answer the age-old question, "Whence came life on the earth?"

Bark Cloth from Africa

Profile of a primitive clothier. His hands transform rough bark into cloth that rivals the product of our modern looms

By Lucy Pope Cullen

"Tomorrow," said Mofia, "I will make a piece of bark cloth for Mama."

When I had rallied somewhat from the shock of being called "Mama" by a patriarch who remembered the Angoni Wars of the last century, and who had personally seen Doctor Livingstone, I replied politely:

"Mutende, Mofia!"

"Mutende" is an extremely useful word in the bush country of Northern Rhodesia. It has no very definite English translation, but is used to express greetings, thanks, approval, encouragement, cordiality; in fact all of the more social emotions. Even if you can't say anything else in the local African languages, this one remark will take you a long way, because it shows any native that you meet that you have been well brought up and that your intentions are good. When you have learned to clap your hands, as if applauding, and to nod your head in unison with the clapping, you are well on the way to becoming really at home in the Northern Rhodesian bush.

When I had clapped, nodded and said, "Mutende, Mofia," Mofia clapped, nodded and said, "Mutende, Mama." Mine meant, "Thank you, it is very kind of you to offer to make me a piece of bark cloth," and his meant, "Not at all; it will be a pleasure!"

Beyond civilization

Mofia is a member of the Lala Tribe of northwestern Northern Rhodesia. My husband and I were in the Lala country on one of our periodic camping trips. We lived at the Roan Antelope Copper Mines, just below the Northern Rhodesia-Belgian Congo border. We often spent our holidays driving through the surrounding bush; camping and making side excursions on foot or by mashila. We found it the best way to see something of the native life of the territory. There were eleven thousand natives living at the Roan Antelope mine, but seeing them there was not at all the same thing as seeing them in their natural environment. When they come to a European community to work, they quickly don European clothes, including horn-rimmed spectacles; they buy bicycles and gramaphones, cooking utensils and farm implements. They play football and go to moving picture shows. Their children become Boy Scouts, Girl Guides and golf caddies.

To get away from what is popularly known as civilization, it is, therefore, necessary to strike out into the bush, away from the main roads and the European towns. Since Northern Rhodesia has an area of 287,950 square miles, with a European population of about twelve thousand and a native population of over a million, this can be done fairly easily.

We tarry

When we came upon Mofia's village during one of our rambles, we intended to exchange a piece of the antelope we had shot for some eggs, and then to go right on. So cordial and friendly were the villagers, however, and so thoroughly had we ourselves fallen into the leisurely ways of the country, that we ended by pitching camp nearby and staying several days. It was a tiny community of only about 150 people. I call it "Mofia's village" because he was its Headman, acting as general supervisor of manners and morals and settling disputes among the others. Mofia was also the official maker of bark cloth. His father and his grandfather had made it before him, and he took great pride in the family craft.

Back in the little bush villages life goes on much as it has for hundreds of years past. The people dress almost exclusively in bark cloth; they make practically everything that they use. There is in each community a blacksmith, a potter, a mat weaver, a basket weaver and a bark cloth maker.

The right tree

On the morning following his offer to make a piece for me, we went to the village to watch him do the work. The first step was to find a suitable tree. Accompanied by most of the village, we walked for some distance through the bush, passing, of course, thousands of trees en route. Most of these Mofia ignored entirely; though he paused occasionally to break off a twig and bite it, or to crush a leaf in his hand. Each time he muttered a few words to himself, shook his head and passed on. In the interests of general information I asked what sort of tree he was looking for. There were, Mofia informed me, many sorts that could be used, but the particular tree had to be of the right age.

"What age?" I inquired, still hopefully pursuing knowledge; though the five years I had already spent in Northern Rhodesia should have taught me better.

"Not too old, Mama," replied Mofia, looking pained that I should have to have such an obvious point explained, "and not too young."

The final selection was a Musamba tree, which measured about eight inches in diameter. Mofia had brought along an adze made in the village forge. With this he felled the tree, chopped off a three-foot section and cleaned it of its rough outer bark. Slitting the exposed white layer of bark from end to end, he hammered it briskly to loosen it and then pulled it from the log in a single piece, about a quarter of an inch thick. Holding this upright with one hand, he shaved it with the adze down to about an eighth of an inch. So skilfully did he wield his crude little implement that the shaved bark was as smooth as if it had been planed. It was now placed in water to soak until the next day.

Mofia, it should be noted, was at least eighty years old; probably more. An African of his generation seldom knows his exact age; he tells you how tall he was or how many children he had when a certain event took place. Mofia's oldest child, he told us, was almost shoulder high when Livingstone died. Yet all the time he worked on the bark, this octogenarian squatted on his haunches on the ground, his back erect and his knees flat against his chest. It is an attitude that few adult Europeans can maintain for more than a minute at a stretch—granting that they can assume it at all, which is highly doubtful. Mofia rose from several hours of this jack-knife posture in a single motion, without even putting his hand to the ground to help himself up. As I creaked slowly to my own feet, the thought occurred to me that perhaps "Mama" wasn't such an unsuitable name for him to call me, after all.

Bark to cloth

When he took the bark out of the water next morning it had turned a dark, reddish brown, and was pulpy and soft to the touch. Now came the most important part of the job, and the one whose execution draws the line between the expert and the amateur maker of bark cloth. Resuming the jack-knife posture, Mofia spread the bark out on a log, and began to tap it gently all over. The implement used was shaped like a hatchet, but had a blunt, double edge. The whole surface of the cloth had to be tapped twice, the second time cross-wise of the first. A false stroke would, of course, have made a hole in the soggy material. It took Mofia three hours, but he did not miss a fraction of an inch of the surface; nor did he once cut through it.

The whole village sat with us to watch him do the tapping. Mofia, evidently feeling his responsibilities as host, told us a number of stories as he worked. The natives in these villages spend a great deal of time simply sitting in the shade carrying on endless conversation and telling endless stories. Of course everyone knows the stories but this never dulls their enjoyment. Each listener chips in with details and embellishments that the narrator omits. A single story with the most elementary plot can be made to last for hours, and it usually does. Time means little anywhere in Africa; and in such a village means nothing at all.

The villagers as usual were thoroughly familiar with Mofia's stories, and supplied the usual Greek chorus effect. It is impossible for an African to do anything without falling into rhythm; Mofia's tapping accompanied his soft, sing-song voice like the beat of a small tom-tom. The tale that stands out most distinctly in my memory was related as an actual experience of Mofia's:

To the land of the dead

He died once, Mofia said, and went to "M'bonshi," or Spiritland. After two days during which he was greatly embarrassed because nobody took the slightest notice of him, a disembodied but awful voice suddenly called his name. So frightening was it to hear this voice coming from nowhere and yet from everywhere at once, that Mofia fell down flat on his face. The voice said that Mofia's presence in Spiritland was a mistake; that he had not been called yet, and that he would have to go back to earth and wait for his call to come.

He is waiting now, he said, but next time he goes to Spiritland nothing will surprise him, for he knows just what it is like. He described it as a vast place with huge stones piled on top of one another. The best part of it was that he saw in Spiritland every kind of antelope in the world. There were all that he knew, and a lot that he had never seen before. The villagers chimed in here to help him name the various antelope; they evidently loved this part of the story, and lingered over it as long as possible. White teeth flashed in black faces, eyes shone, the tapping accelerated and became gay. Spiritland, with all those antelope, was plainly going to be a very happy hunting ground indeed.

Spiritland, went on Mofia more soberly, after they had finished with the antelope, was divided into two parts; if you get into the second part you never come back. He, of course, was only in the first. He saw some of his dead friends, notably his own father, looking at him from the second part, but was unable to communicate with him.

"There I was," said Mofia, tapping sadly now, as the villagers murmured and shook their heads in sympathy, "like a noodle, where I wasn't wanted, and I could not even speak to my old father!"

The clinching proof that the place was indeed Spiritland lay in the fact that Mofia's father was dressed in the very piece of bark cloth in which he, Mofia, had wrapped him for burial when he died. The shock of the whole experience was so great that for some time after Mofia returned to earth he could not talk properly, but could only gurgle like water coming out of a bottle, to judge by the joint demonstration with which he and the villagers concluded the narrative. So obviously convinced were they all of its entire reality, that we could only listen in respectful silence, and surmise that he had suffered delirium, or perhaps had a vivid dream.

By the time the story had reached its end, the bark cloth had been tapped sufficiently. Stretching was the next step; this was done by twisting it as you wring a towel and pulling it at both ends. It stretched amazingly; when it was finally untwisted it was at least four times the size of the original piece of bark. It was then oiled, to toughen and preserve it. Castor oil beans, grown in the village, had been boiled up into an exceedingly evil-looking, dark gray mess, which Mofia intrepidly scooped up with his hand and patted over the surface of the cloth. The oil-soaked material was finally dried for several hours in the sun.

When it was quite finished, Mofia brought it over to where I was sitting and laid it on the ground at my feet.

"Mutende, Mofia," I said, "It is beautiful. Mutende!"

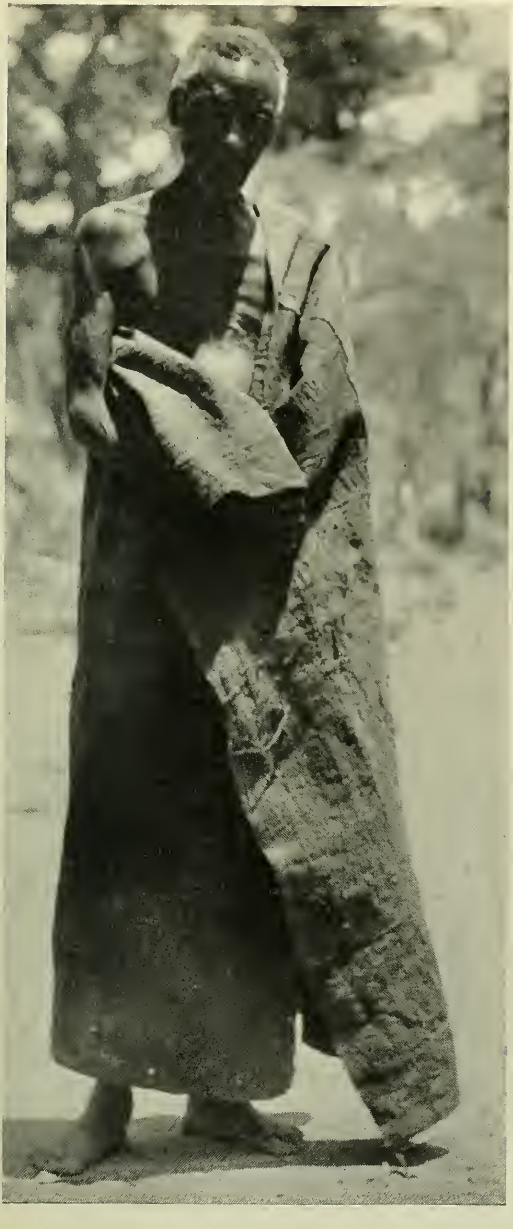
"Mutende, Mama," said Mofia, smiling as he clapped and nodded.

"Mutende, Mama," echoed the faithful villagers.

A memento

While it was a little stiff at first, the cloth has limbered up until it is as soft as a wool blanket. The marks of the tapping give it the exact texture of a woven material. It is remarkably strong and durable; the friends to whom we show it can seldom resist the impulse to see if they can tear it. So far no one has succeeded. It exudes a pleasant, woody odor, rather like that of a cedar chest.

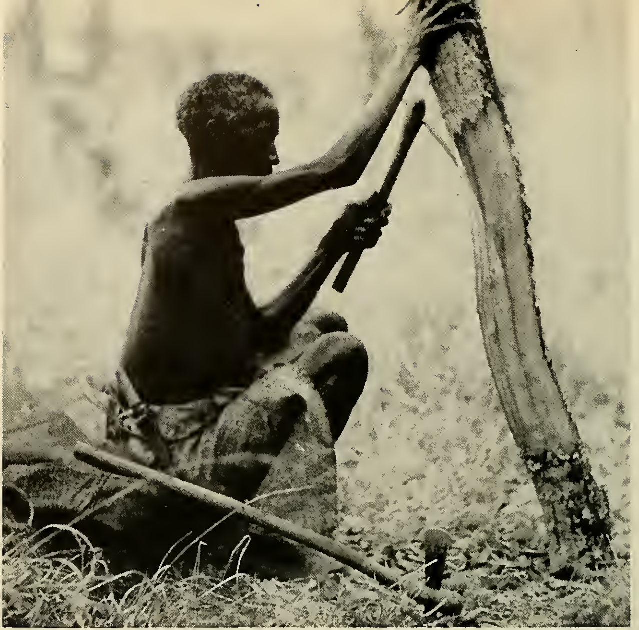
It is not, however, these virtues that make the cloth one of my most cherished possessions. In its brown folds are memories of a tiny village far out in the African bush, and of a slow, easy-going way of life; of a circle of happy, absorbed faces surrounding an old man, squatting on the ground, tapping rhythmically and telling of the antelope in Spiritland. The cloth is like a piece of Africa itself.



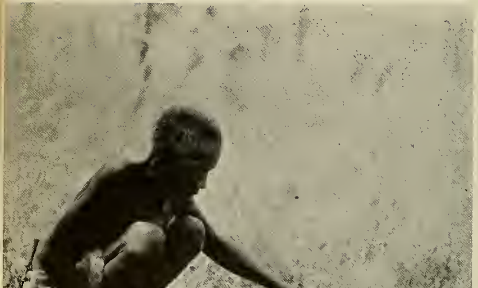
Bark Cloth from Africa

THE MAN *who knew Livingstone: Mofia, venerable patriarch of a drowsy African village, supervisor of the manners and morals of 150 natives clothed almost entirely in Bark Cloth*

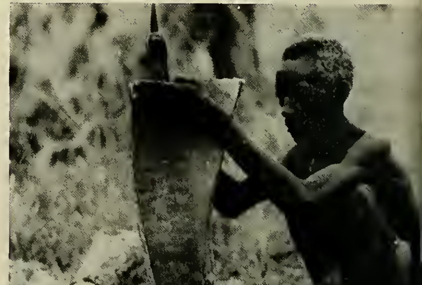
All Photos by A. Douglas Cullen



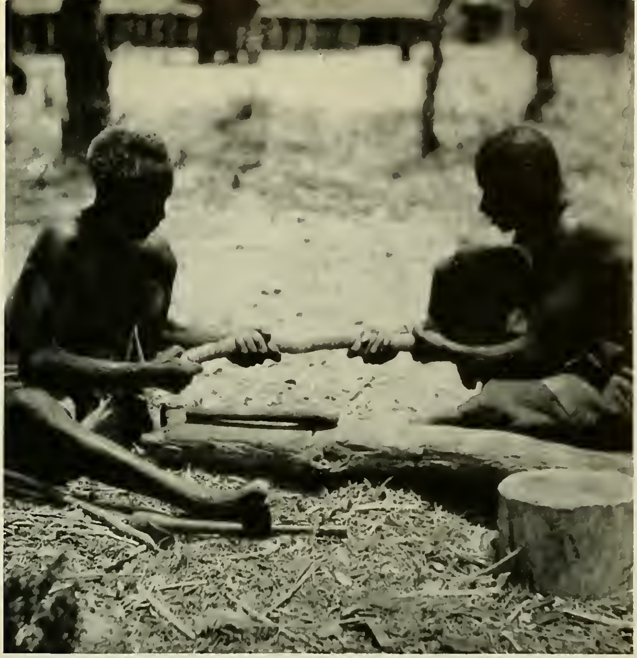
(Above) MOFIA'S RAW MATERIAL: *Chipping away the rough outer bark with an adze made in the village forge. At least eighty years old, Mofia can work in this jackknife-like position for several hours*



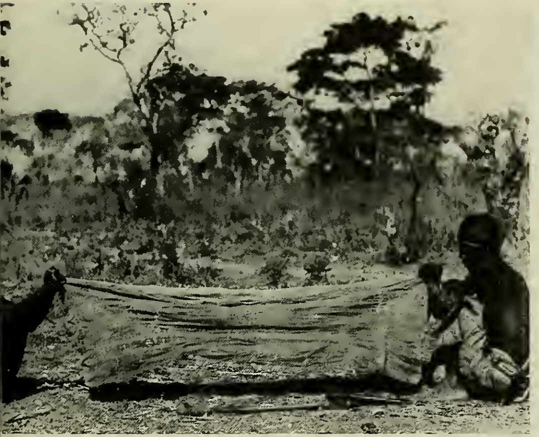
(Above) LOOSENED BY BRISK HAMMERING, *the bark is pulled off the log in a single piece by the skilled hand of the primitive craftsman*



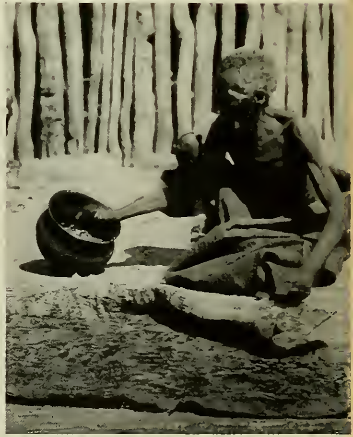
(Above) SHAVING DOWN *to an eighth of an inch. No carpenter's plane excels the home-made adze when manipulated by Mofia*



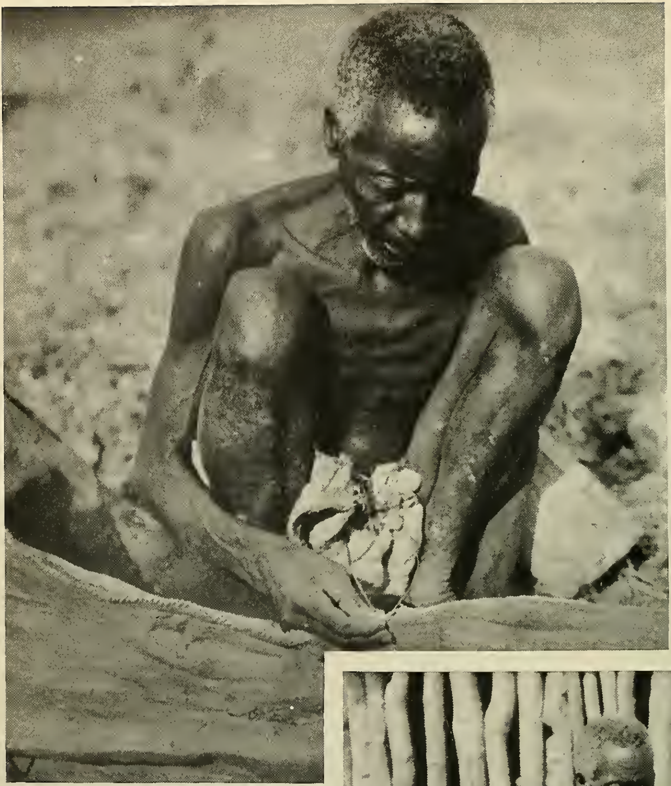
(Above) BARK CLOTH, NOT TAFFY: *Mofia and assistant stretching the cloth after it has been soaked in water then pounded with a hammer to the rhythm of Mofia's tales of the spirit land*



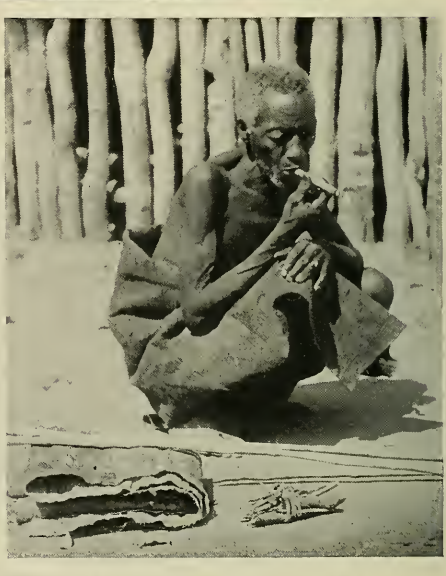
(Above) UNTWISTED, *the cloth has stretched to four times the original length. Now, Mofia can add the finishing touches*



(Above) CASTOR OIL FOR "TANNING": *Mofia softening his handiwork with a native fluid brewed from castor beans*



(Above) SEWING CALMLY *in a land where time means nothing: Mofia's thread is a strand of bark, his needle a product of the village forge*



(Right) HIS JOB COMPLETED *Mofia gets a "lift." The cigarette is a section of reed, filled with tobacco*

More Fun with Sharks

The crowning episodes of a shark fisher's long experience—encounters with the voracious Tiger Shark, in Bahaman waters

By COLONEL HUGH D. WISE
U. S. Army, Retired

STUDY had verified for me the tradition that the waters of the West Indies are the habitat of sharks in great numbers, of many species of unusual size and ferocity, and I was anxious to have a try at them with rod and reel. Through Mr. H. S. Mazet, co-author with Captain Young of a recent book, *Shark! Shark!,* I met Mr. Gillette, President of the National Fisheries Corporation, a commercial company engaged in shark-fishing, and I was soon in correspondence with the resident manager of the company at Nassau, Mr. E. M. Schuetz. Him I found to be not only thoroughly informed as to sharks but also to be a sportsman, ready to help us with the preparation of the little expedition which I was planning.

I think, however, that Schuetz was a little nonplussed at the idea of fishing for sharks as sport-fish with rod and reel. Nevertheless, he got my idea and he thought that the Bahaman Tigers would give me all the fight I was looking for. "Tiger Shark!" The very name sends cold chills through the marrow of a Carib and pictures to the shark-hunter the great brute which it so well describes.

Tigers abundant

Schuetz reported them large, savage, and abundant. A letter from him told of the return of one of his parties with fifty-one sharks; thirty-one of them Tigers, two fourteen-footers and one sixteen-footer. That letter settled me—I was going! A sixteen-foot Tiger would weigh upwards of a ton and could not be held on a rod, but what fun trying to do it! The ten-footers, weighing six or seven hundred pounds, could be handled.

News went to Schuetz that we were coming and he began looking up a boat for us.

My son, Hugh, is as keen a sportsman, or should I saying "fishing crank," as is his father. My son, John, a Princeton undergraduate, is deeply interested in biology and zoölogy, and since Professor Dahlgren, of the Biology Department, Princeton University, a fishing companion of mine, could not go with us, John had to be our biologist, but Dahlgren wrote a letter bespeaking for us interest and help. J. Victor Coty, the lecturer on fishing and an expert movie cameraman, joined us to take movies of the sport, undeterred by his experience in roughing it with Dahlgren and me before.

Season

People who are unfamiliar with the tropics invariably have exaggerated ideas of the heat, so we were the recipients of the usual criticism for having selected summer as the time to visit Nassau. Had we wished to do so, we could not have avoided this, because we were after sharks and midsummer is the best season for them, and later in the year hurricanes make being out in a small boat impracticable. As a matter of fact, however, the heat in Nassau is no worse than that of midsummer in New York and the thick-walled, high-ceilinged houses with broad shaded verandas surrounded by palm trees make it endurable. Sitting in the shade of palms, fanned by ocean breezes, and sipping a Planter's Punch, one can really pity people at home.

June 16th our party, equipped with eight rods, miles of line, and dozens of hooks and leaders; harpoons, harness, and tackle-boxes; silk nets and bottles of formaldehyde for the biologist; endless paraphernalia for the photographer, and, incidentally, some clothing; embarked on the *Munargo* at New York. Bound on such an expedition, we were naturally more or less curiosities to other passengers but their interest in our doings was rather surprising. On the passage we were kept busy answering questions like: "How big are sharks? Do they really attack boats? Do they eat men?" One young man was nervous about them on bathing-beaches and wanted to know if there was much danger from sharks in the water at Coney Island. "Not as much," I replied, "as there is from rusty old tin cans, but *bottles* are probably the greatest danger there."

"Suppose a shark jumps into your boat?" asked one girl, in perfect seriousness.

"Then," said I, "I should write an article, for that would be news."

Swimmers among sharks

Two and a half days out from New York we slid into the amethyst Harbor of Nassau to be greeted by a score of dinghies each laden with chattering, shouting, native boys who howled that coins be tossed for them to dive after. Now, these waters are infested with sharks but the boys are never hurt by them. They are really in no danger from sharks because the shark, is, in fact, a timid creature which keeps away from such commotion as is going on. If the sharks were chummed up and excited by the scent of food or blood, these boys would not last long, but as it is they have little to fear. I would readily insure them for a very small premium but I would not go in there with them for a considerable sum. There you have one of those anomalies which apparently attach to most shark lore. The government seems to recognize the element of safety in the noise and crowd of the harbor, for it forbids these diving boys to ply their trade outside.

For some inexplicable reason, sharks are particularly suspicious of dark objects while light-colored ones seem to attract them. They will take, as bait, a skinned fish in preference to a fish with dark hide and they seem to prefer whitish fish rather than dark ones. This is strange, because darkish skates and rays are their favorite natural food; these, however, are light underneath.

A striking example of the attractiveness of light objects to sharks is told by Captain William Young who says that one day when towing a dead black horse to attract sharks, a shark followed but would not come within harpoon range. When a newspaper was thrown overboard, however, its white flash caused the shark to dash up and he was harpooned.

Camouflage

Captain Young, in his wide experience with sharks, intimates also that this peculiarity makes the negroes of the West Indies more immune from shark attack than white men. He tells how native divers smear their white palms and soles with tar, but one scientist believes that the protection is due to the fact that sharks do not like the smell of tar and that even the smell of marlin will keep them from a bait. Quite opposed to this theory, Mr. Schuetz uses tar liberally on his equipment. The buoy and anchor lines of his nets are of steamed tarred rope, and bait is tied to the meshes with tarred marlin, all of which does not seem to discourage the sharks. On the other hand, Schuetz absolutely confirms the idea that sharks are attracted by light-colored objects and for that reason he has, after experiment, adopted white nets which he has found to be superior to those of the various colors tried, or to nets camouflaged to resemble the bottom. In my own experience, I have noticed no advantage in any color of line, white, green or natural.

I mention all this to show how different are opinions as to the likes and dislikes of this fish.

While we hung over the rail watching these aquatics in which the prizes go immediately to the most efficient, Mr. Schuetz bustled aboard to meet us—clean-shaven, in a crisp linen suit and wearing a straw hat, the typical business-man of the tropics. He was so bubbling over with interest and so generous with his help that, after thanking him for what he had already done, I could not resist asking why he was so good. "Because," said he, "I am a sportsman and I like to help other sportsmen," and certainly, while we were in the Bahamas, he lived up to that ideal.

Tackle and equipment unloaded, Hugh and I went across the dock to look over the boats that Schuetz was holding tentatively for us and selected the *Malolo B.*, a thirty-nine-foot modified "sea-skiff." She was sound, clean, and well-engined; there were bunks for four, galley, toilet, and facilities for food and ice storage. Aft there was a roomy cockpit and two swivel chairs. What appealed to me immediately was that the helmsman's wheel, in easy reach of all controls, was forward of the chairs but in plain view of them. There were some details about the boat which might have been better, for example: there was no hoisting crane for taking aboard big fish, but all in all, she was surprisingly well suited to our purposes, and it must be remembered that our demands were unusual.

No one at Nassau had ever seen sharks angled for with rod and reel and the ideas of John and Coty had never risen above the local horizon. Altogether, we were undoubtedly pioneers but the natives probably regarded us as a bunch of "nuts." At first the boatmen, though politely humoring us, clearly could not understand, and Schuetz alone seemed to get the idea.

Life in Nassau

When one steps ashore in Nassau, he is at once impressed with the ease and comfort which the population, mainly black, enjoys.

As in other British colonies, the streets are clean, but how narrow they are! Cars pass cautiously, and at corners they must stop and honk before turning. One never knows what he may meet around a corner—a bicycle, a donkey-cart, or a wheeled sponge-crate, and all vehicles keep to the left of the road, thus adding to the American's confusion. Horse-drawn surreys are still a popular means of transportation in Nassau, so when Hugh and I had finished our arrangements at the boat we chartered a surrey to take us to the hotel, but when the poor old horse could not pull us up the hill, the driver descended from the box and pulled with him.

With its abundance of tropical foliage Nassau is quaintly and exotically attractive. Sponge marketing, the most important industry, is interesting, though drab in color; but another, grass-weaving, fills the street markets with pretty baskets and bright colored hats, which are urged by the native women vendors on the visitor. Our party purchased some of these, but was saved from buying hundreds of them only by the greatest self-denial. Hugh's photographs show him fishing under the shade of a gaudy headgear which was evidently intended for a black Nassau belle.

We were there, of course, out of season, so most of the big hotels were closed, and we made our headquarters at the old Royal Victoria which, with flagstone terraces, wide balconies, its general rambling design, and total disregard of space, is distinctly tropical.

Departure at dawn

During the day Schuetz had given us all possible instructions and mainly on his advice we decided to start our shark hunt at Andros Island. After dinner at the hotel Hugh and I went aboard ready to sail at daylight, the boat, equipment, and tackle all checked and the charts studied.

Nothing could have been more propitious than our start at dawn on that beautiful morning. Out of the placid harbor, our engine purring rhythmically, we glided onto a gentle rolling sea. Green palms fringing the coral shore nodded farewell in the gentle breeze, and houses pink in the rising sunlight blinked good luck.

Those broad inland waterways between the Bahaman Islands surpass all description, for, exquisite as are the pastel tints along the shores, still more beautiful are the shades of blue and green separated from them by the line of feathery, foaming white breakers, and, over all, great drifting masses of cumuli, glistening white, silver, rose and gold beneath an azure sky. The breath of early sunlit morning is in the breeze which soothes the temples, the tang of the sea is in the spray which feels good on face and tastes good on lips. The very bound of the boat seems to lift one's soul above all that is of the drab land.

Bearing away from New Providence Island, land sinks from view beneath a rolling sea which now in full daylight takes on in one direction the deep blue of the Mediterranean and, in another, the brilliant green of the Chesapeake.

Poets and artists would stop the engine to lie here and drink in all this loveliness, but we are only fishermen so we open the throttle and drive on toward the sport of which we have been dreaming. Southwest we head, fifty miles to Andros Island, the former rendezvous of famous pirates and still the habitat of giant sharks, swashbucklers of the sea as bloodthirsty and as relentless as were Morgan and Blackbeard.

Barracuda as bait

At noon we slowed down off High Cay to troll for bait, but this is not the drudgery one might think it to be, for the bait was barracuda and that big game-fish is itself well worth coming for. Not to miss any of the sport, we used our light tarpon rods and made the most of the fights.

Barracuda are as savage as sharks and as relentless in the toll they take of other fish. About the only thing in the sea which they will not attack is the shark, for about the only thing they cannot tear with their terrible spiked teeth is the denticled hide of a shark. The barracuda is really more to be feared than the shark because he can and does frequent the shallow waters of bathing beaches where deaths and injuries inflicted by the barracuda far exceed those inflicted by the shark who is blamed for many of them.

Hardly were our lines out when a big barracuda struck and sizzled off two hundred yards of Hugh's line in a glorious run. Then my reel shrieked and a big barracuda took out two-thirds of my line before I checked him. In about ten minutes I had him coming and within a hundred yards of the boat, when a shout went up—"There's a shark after him!" The barracuda leaped and came down into the white surge which followed him, an added strain came on my twelve-thread line and my rod bent into a semi-circle. Then the line slacked and I wound in a barracuda's head, the shark having kept the rest of the fish as his share. It must have been a Mackerel Shark because we were trolling at about five miles an hour and other sharks rarely strike at such trolling speed.

One of the barracudas we caught was such a beautiful specimen that Burt, the Carib boatman, looking at him, remarked—"He looks good enough to eat."

"Certainly," I replied, "we will eat him tonight."

"No!" shouted he and the captain in horrified chorus, "He's poisonous!"

I had always thought that fish-poisoning was entirely due to the ptomaines of partial decomposition and knowing that this fish was fresh, I attributed their protest to native superstition, but I humored them and we did not eat the barracuda. Later inquiry proved, however, that this belief was general in the Bahamas, so on my return to New York, I reported it to Doctor Gudger of the American Museum and then I learned how ignorant I had been, for in the West Indies there is a well-known disease, *Ciguatera,* caused by the eating of certain fish, among them barracudas, whose flesh, particularly in the breeding season, may be impregnated with toxic secretions.*

With enough bait, and having had great sport getting it, we dropped over to the shark grounds in the channel, slowing down to lay a slick as we drew near.

A fin

I was first in the chair, and Burt put half a barracuda on my hook. Before we came to a stop and while Burt still stood holding my baited hook in his hand, a big fin came up in the streak twenty-five yards astern. "Throw it!" I yelled and "Plop!" it hit the water a few yards in front of the fin. A swirl—a rush—he had it! I struck, and out went the line with the high pitched whine of the reel while Hugh strapped me to the chair. We had a great fight, that shark and I, or rather I did, before his ugly Tiger mouth showed at the surface ten feet away about an hour later. It was Burt's first throw but he drove the dart deep just above the pectoral fin and as the lanyard whirled from the bucket, he gradually snubbed it around a cleat. Then the shark was hauled in.

When we came back to the slick I surrendered the chair to Hugh who immediately became engaged in battle with another three hundred-pound Tiger. He had a more difficult job than I had had, because we had anchored to hold against the tide and the anchor was down when he got his strike. We could not get it aboard, and dangling aweigh three fathoms below the bow, it seriously interfered with our maneuvering. Nevertheless Hugh brought his fish to iron in good style.

Each took several more sharks that day and we both had tired backs when we quit to make the anchorage before dark behind the reef at Mangrove Cay. We had come after Tigers and

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*Gudger, Dr. E. W., *Poisonous Fishes and Fish Poisons.* Am. Mus. Nat'l History. *Am. Journal of Tropical Medicine,* Vol. 1, No. 1.

here they were. There was one slender fish of about fifty pounds which still showed the leopard spots characteristic of young Tiger Sharks. A second, weighing about three hundred pounds, had distinct tiger stripes on his sturdy body, and a third, about the same size but evidently older, was of uniform brownish-grey, showing indistinct stripes only near his tail. Both of the larger ones were vicious devils and when their blunt noses came up their big jaws, with cruel triangular serrate teeth, were snapping like bear traps and we understood the dread they inspired in the natives.

The presence of a party like ours in harbor at Mangrove Cay is quite an event, so I, who remained aboard while the others went ashore, received many callers who paddled out to satisfy their curiosity, and whom I energetically pumped to satisfy mine. When the shore party returned they brought some turtle meat, langousts, fresh fruit, and a gunny sack full of green cocoanuts, whose milk, that most refreshing of tropical drinks, served us well in the days to come.

An outpost village

Mangrove Cay is a native town of about twelve hundred inhabitants stretching in a single row of palm-thatched houses for nine miles along the shore. Mr. Forsythe, the British Commissioner, is, I believe, the only white man there but he seems to like it for he has been there twenty years. Mangrove Cay is his kingdom where he is ruler, counselor, friend, and advisor to all, in sickness and in health—one of those Englishmen who extend British influence more, perhaps, than it is carried by conquest.

The natives are a mixture of Carib and Negro, varying in type between the two. Some of them appear to be pure Carib, with thin nose, high cheekbones, straight hair and bronze skin while others are distinctly West Indian negroes. All of them impress the visitor by their kindliness and good humor even more than they surprise him by their ignorance. Their friendliness to us was demonstrated by their insistence upon a ball in our honor. Of course we were expected to pay the musicians—one of their popular songs carries the refrain, "Fine gal, take care of the rich man sailor."

Andros Island is some hundred miles long and forty wide, but very low. From natives we heard of fresh water lakes in the interior in which were to be found sharks, barracuda and other pelagic fishes which, of course, may have been swept overland into them by great hurricane waves. The sharks are reputed to be of great size and ferocity, so fierce, the natives said, that the government had warned them to avoid those waters, but I am inclined to believe that such sharks, if or when there, are but trapped and temporary sojourners rather than permanent residents and that, sooner or later, they will succumb to these unusual conditions.*

The physiological processes of sharks are apparently not so well adapted to life in fresh water as are those of some other fishes, various teleosts for example. Certain small rays are known to live permanently in some fresh water rivers of South America, sharks do ascend the Ganges far above salt water, and sharks are found in the land-locked fresh water of Lake Nicaragua. There is considerable doubt, however, among scientists as to whether these Nicaragua sharks are a misidentified form of wanderer from the sea or whether they are a fresh water species.

After a number of highly exciting encounters with Tigers on June 23rd we had to run back to Nassau for ice and supplies, and a good night's rest in a comfortable bed would not be unacceptable. Also, I had picked up considerable native lore which I wished to discuss with men in whose opinions I had confidence.

A quick-change artist

One such notion was that a Nurse Shark, when attacked, could tighten his hide to resist the harpoon. Natives generally believed this, as also did the British Commissioner who thought it might be the origin of the native expression, "setting his skin," by which they imply a man's "preparation to resist." Mr. Schuetz, Captain Brown, and the crews of the shark-fishing tugs of the National Fisheries Corporation, all confirmed this and were willing to be so quoted.

Other sharks, too, may have this same capacity and experiments proved to me that a harpoon which would bounce from the hide of a live shark, as from a steel plate, could be easily driven into it when the fish was dead.

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*Report of C. M. Breder, Jr., "Ecology of Fresh Water Lakes, Andros Island," N. Y. Zoological Society, Vol. XVIII, No. 3.

The next year, Schuetz, on the basis of experiments and observations made by him, offered the following explanations: in the hide of a Nurse Shark, the denticles are set somewhat like hexagonal tiles in a bathroom floor, the tissues between them being like the cement between the tiles. When agitated or touched, the shark voluntarily or by a reflex action draws these "tiles" together so that even a harpoon point or a knife edge does not penetrate between them, thus "setting his skin" into a continuous sheet of resistant armor plate.

Attacks by sharks

I especially wished to check up on those lurid yarns about fights between man and shark in the shark's element—water.

There are reliable accounts of swimmers who have rescued others by frightening away the shark, such, for example, as the heroic saving of a man in Australia for which the rescuer was decorated by the King. Personally I have never believed that a man swimming could successfully fight a big shark with a knife. To drive a knife through the denticled hide would require tremendous power, and there would be small chance of its reaching one of the two vital and well-protected spots, heart or brain, even though the shark remained passive during the operations. Meantime, one slash with his teeth or one wallop with his tail would end the fight.

Though I have minimized probability of danger from shark attacks, yet I recognize that there are many well-authenticated instances in which sharks have attacked men and even boats.

Doctor Gudger has told me how at Key West his boat was attacked by a large wounded Tiger Shark who splintered the boat-stem with his strong teeth. Doctor C. F. Holder, in his book, relates similar experiences at Tortugas. Of course reports of such scientists are incontrovertible.

Mr. E. M. Schuetz has recorded his personal experiences in his diary, from which he allows me to quote these instances.

In May, 1934, in the Berry Islands, a large Tiger Shark, wounded by a harpoon, turned upon a ten-foot dory, seized its bow in his jaws and shook the boat so violently that its three occupants were thrown into its bottom. "We were like ice in a cocktail shaker," said Schuetz. Such an experience, however, does not seem to have chilled Schuetz' enthusiasm for shark-hunting nor to have unsteadied his aim with the harpoon.

In June, 1933, at Gorda Cay, a Mackerel Shark which Schuetz was chasing, turned upon the dinghy and left some of his teeth in the keel. In the same month, a Yellow Shark, missed with the harpoon, seized the shaft in his teeth and bit it into three pieces.

To my mind, these incidents do not indicate aggressiveness on the part of the sharks but rather retaliation to attacks made upon them.

One of the most exciting experiences related to me by Schuetz was that of a large shark, who, when hooked on a hand-line, seized the rudder and then the propeller of the boat which he might have capsized had he not been cut loose.

Another of Schuetz' accounts seems to show not only the viciousness of a shark but also some degree of intelligence. While Schuetz was casting from a ledge, a large shark tried to swipe him off with its tail. Schuetz, dodging the tail, quit fishing and clambered up from the ledge, which shows, at least, that Schuetz had reasoning power.*

At Nassau the following story was widely circulated and I was able to interrogate several witnesses. Six men had been recently drowned from a capsized boat. The bodies lay at the bottom while sharks circled around but did not disturb them. When, however, the bodies began to be raised with grappling-hooks the sharks dashed in and tore them to pieces. It would seem that the semblance of life which movement gave them attracted the sharks.

If caught among sharks

The discussion of all this with experienced fishermen in Nassau led naturally to the old question of what a man should do if he found himself in the water with sharks near. All of us agreed that he should kick, splash, yell, and raise all possible commotion but none of us would wish to be held responsible for giving such advice. Frankly, under such circumstances, I should be willing to let the shark have the swimming hole and I would raise no question of riparian privilege.

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*Further consideration of this incident, however, leads Schuetz to believe that the shark was really not swiping at him, but simply swung his tail out of water with a sudden turn when he was frightened by another man on the bank. What a pity to spoil such a good story.

The foregoing stories, received first-hand from men whose training and experience eliminate probability of excited exaggeration or hasty conclusions, can be taken as bases for deduction.

Davy Jones's surprise witness

A remarkable story, vouched for by the Secretary of the Institute of Jamaica and for which there seems to be documentary evidence, is that, in the 18th century the American privateer *Nancy* was seized by *H. M. S. Sparrow* in the Carribean Sea and her captain was taken to Port Royal for trial. Because of lack of evidence against him, the captain was about to be acquitted when the commander of *H. M. S. Abergavenny* came in with the ship's papers of the *Nancy* which had been thrown overboard but which the commander of the *Abergavenny* had taken from the stomach of a shark caught off the coast of Haiti. On the evidence in these papers the captain of the *Nancy* was convicted. These papers, known as the "shark's papers" were put on exhibition in the Institute of Jamaica where it is said they may still be seen.*

The only shark attack which has ever come under my personal observation occurred in the Philippines, where my battalion was resting up at a God-forsaken little coast town after an arduous campaign. One of the fish pounds had been torn loose at the bottom from the supporting poles, and a number of canoes clustered about it for repair work. The first native to go down, taking rattan withes in his teeth, dove in. Hardly had he disappeared when there was a swirl below and he popped to the surface followed by a huge shark which whirled and dashed away. Amid great noise and confusion the man was hauled into a canoe. His loincloth had been ripped from him and on his thigh were two ugly crescent-shaped lacerations from shark teeth.

My explanation of this incident is that while the shark lay at the opening in the pound, the diver plunged almost onto him and that the surprised shark whirled and seized the man. Having tasted blood, the shark might have been expected to finish the diver but, following him to the surface, he was frightened away by the commotion in the canoes. Be that as it may, the bitten man gave up fishing and thenceforth took employment on a copra plantation where, in the tops of coconut palms, he probably felt safe from sharks.

We got a late start from Nassau on the morning of June 24th, because it was the birthday of the Prince of Wales. That made it almost impossible to get a Nassauvian to work or even to bring us supplies—holiday is holiday in Nassau. When we finally did get off we ran to West End Bay, on New Providence Island, but we had saved time by purchasing bait in Nassau.

A novel interest in this fishing in the Bahamas was that we could see through the clear water what was happening at the other end of the line, sometimes five or six fathoms away. In Nassau I had tried to get an electric light bulb on a waterproof cable to connect with the boat's circuit and to be put overboard. The Prince of Wales having prevented this, I contrived an apparatus with the water glass and an electric torch, and with it spent part of the night in observation. The light attracted fish and, though the apparatus was none too satisfactory, I did see some interesting things before a barracuda, leaping at the light, nearly caught my hand and forced me to abandon the contraption.

Fish tactics

At sunrise we went to bait fishing with hand lines, "horsing" the fish in so quickly that we got after the sharks early. Soon after I had taken the chair I was hung onto another Tiger and fought with him till he was within fifty feet of the boat. We saw that fellow several times and knew that he was easily a five hundred pounder but he was not making the fight he could have made. After his preliminary rush he yielded readily to my pumping and then alternately followed in unresisting, or brought the line "solid." When we got a close view this peculiar performance was explained. He was a "roller." He would lie alongside the leader and move along with it, then, in a swirl of water, he would turn across the wire and roll it several times around him. Lying broadside to my pull he could not be budged until my pumping unwound him. Again and again this was repeated. Four turns of the leader around his thick body would bring the line against his rough hide and he seemed to be trying to do just that. Finally he succeeded, and "Snap!"—he was gone with two dollars worth of hook, swivels and leader hanging from his ugly jaws.

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*Brooklyn Museum of Science Bulletin, Vol. III, No. 1.

This was the first time I ever actually watched the performance of this trick but I am satisfied that it has been played on me many times. Once before this I saw a shark suddenly cease pulling, run under the line and sandpaper it in twain with his denticled hide. Unquestionably, too, sharks do sometimes reach the line with their teeth but more often, I believe, they cut loose with the rough hide of their fins or bodies.

The best catch

We returned to the anchor, picked up the gong, Burt laid a new slick and Hugh floated out a fresh barracuda. "Who-a-a" went the reel, with that bass note which means a slow run, and then the fish turned and swam leisurely toward the boat. He did not seem to know that he was hooked or if he did know it he was not in the least perturbed. When we saw him with the hook in his mouth, and saw what a big fellow he was, I yelled for the gong to go over and with Kemp's "Over, Sir!" the shark woke up and gave us a grand run followed by an hour of forward, back, starboard, port, while Hugh pumped and sweated. When the double came up the fight was nowhere near over for, with another surge, out went three hundred yards of line to be pumped back only to go again.

When after several such runs he was brought to the surface a hundred feet away, the shark changed tactics and began surging in small circles, diving and looping underwater and twice he went over backwards, rolling as he looped, like an airplane in an Immelmann turn—all in plain sight and to the accompaniment of a shrieking reel. What a fight! But Hugh was master of it and finally the shark committed the tactical error of swimming too close to Burt's poised dart which flew out and struck into the gills. A rush to the end of the lanyard, now leaving a pink trail behind him, and the shark was hauled in for the *coup de grâce*—vitality and power conquered by a tenth of its strength, now slumped in the chair.

This Great Blue was the finest shark of our expedition and he deserves record of his measurements in this, his obituary: length, 11 feet, 7 inches; girth, 6 feet, 2 inches; weight, 954 pounds.

What a grand four days we had had—three or four big sharks each day and licked by larger ones than we had caught! We had found the lair of the Tiger and we were determined to go back to fight it out with him as soon as we could.

I should like to acquaint readers of NATURAL HISTORY with the many other interesting experiences we had with sharks on that expedition in the Bahamas and on a subsequent one the following year; but space does not permit. Besides, I hope soon to tell the whole story in a book.

L'envoi

There comes an end to every fishing trip; but part of the fun is always planning for the next. Cruising northward last time through the Gulf Stream, the high "gafftopsail" of a Hammerhead followed in our wake and I found myself longing to have him on my line. One might think that six days in a little tossing boat, through four squalls, ought to have taken the edge off our keenness but they had not. Why should a man go to considerable expense, endure many discomforts, and do so much hard work for the sole purpose of matching his wits and strength against those of a fish, when he does not want the fish anyway?

I can explain this no more than Carl Akeley could have explained the fascination of the African jungle—no more than Admiral Byrd can explain the delights of an Antarctic "igloo."

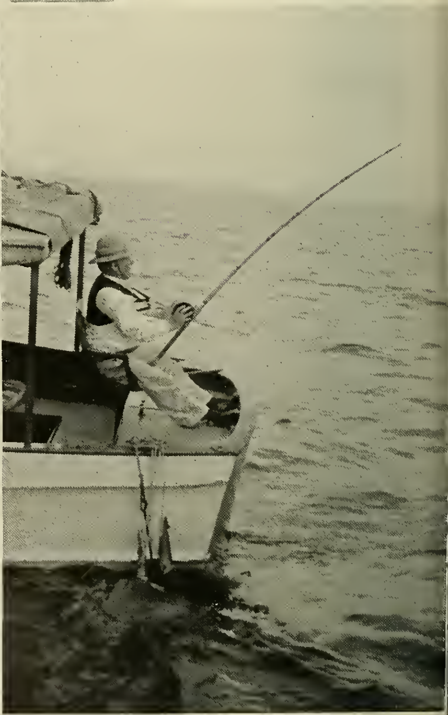
Perhaps it is the primitive instinct some of us have inherited from caveman ancestors and which centuries of civilization have not eradicated but, thank God, love of the chase is still in me, so

WIND IN!

More Fun with Sharks

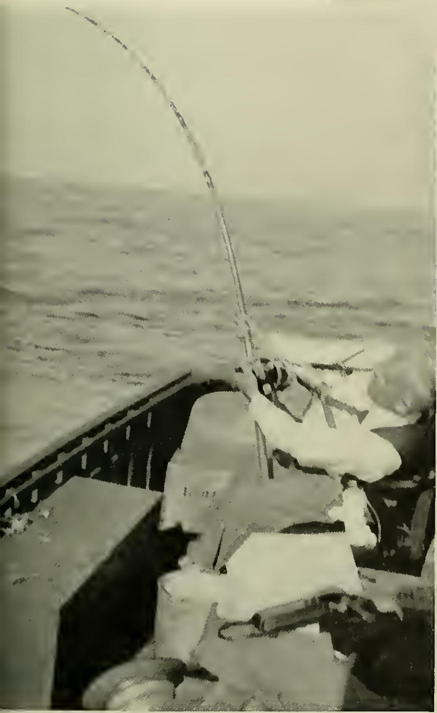
GOOD BAIT: BARRACUDA. *Catching bait in the Bahamas for shark fishing is not drudgery because angling for barracudas is a sport in itself, well worth the coming for*

YOU CAN'T STOP HIM, *so settle back in the harness and squeeze down the drag, while the big rod bows and the line hums like a telegraph wire*

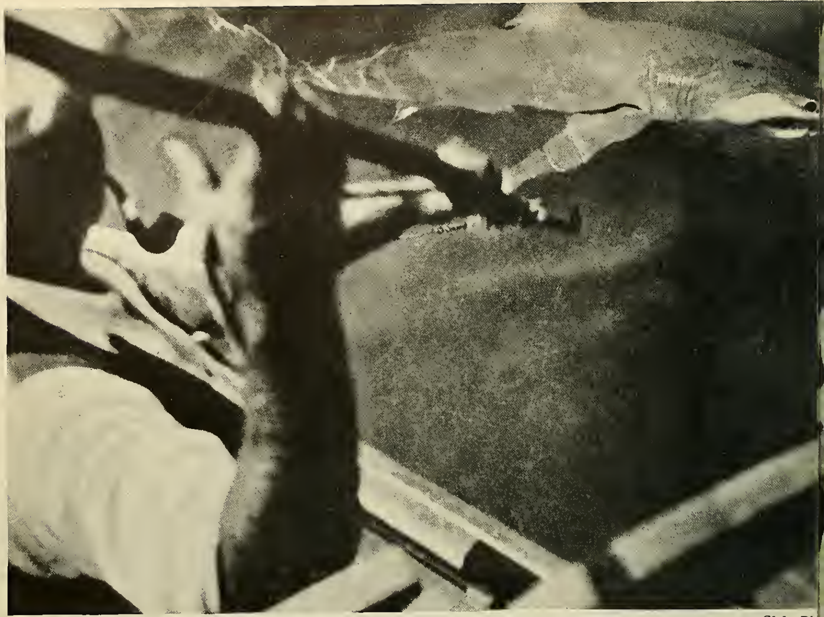


BRACE YOUR FEET *and hold fast when your back will stand no more pumping and your line will not bear the strain of it. Never fight a big fish when he wants to fight. Never let him rest when he does not want to fight*

One who knows sharks, *E. M. Schuetz, Bahaman Manager, National Fisheries Corporation. His business is the handling of them commercially; his fun, the catching of thousands of them*



Pump him up! *Your back may ache, arms may be numb, hands may burn; but you must pump him up*



Globe Ph

(Above) An armed enemy *who would give no quarter. When, with glaring eyes and snapping jaws, he is brought to surface, he excites no pity*

(Below) Ten feet of carcharias taurus, *landed after a three-hour battle*

(Above) "AT THE MAST": *a big Dusky, brought in after a three-hour fight. This* Carcharinus obscurus *is one of the stubbornest of sharks*

(Below) THE ENGINE PURRS HOMEWARD *but the angler, dreaming, still sees dark graceful forms slithering through crystal depths*

The History of the Valley of Mexico

Explore with the archaeologist an ancient trail which leads to the origins of the famous Aztec culture and sheds new light on the evolution of Mexican art

By George C. Vaillant

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[*This article is a résumé of the results of the expeditions by the author for the American Museum of Natural History from 1928 to 1936.—The Editors.*]

That formidable term archaeology might be defined as history which you can see. The casual traveller, observing the architecture, painting, and social customs of a foreign country tends to take the archaeological point of view, since the picture he forms is visual rather than mental. On the other hand the school or college student in learning about that same country, would use printed texts giving the dates of sovereigns, economic situations, and political actions and would thus create in himself an intellectual impression, based on ideas rather than images.

Written records scanty

Now the Valley of Mexico before the Spanish Conquest was inhabited by peoples who developed writing very late in their career. Moreover this written record was largely pictorial so that events could be expressed, but not ideas. Another factor which rendered this textual material even more meagre, was the systematic destruction of the greater part of the native archives, since the Spanish Conquerors believed these writings to be idolatrous and works of the devil. Thus the historian of Indian Mexico finds even the short span of time in which writing existed, very imperfectly covered; and, to form a consecutive picture of the evolution of human culture in Mexico, he must rely on the *visible* remains of Indian culture, the architectural remains, pottery fragments, stone and clay sculptures, frescos, and whatever else has survived the action of time and the destruction of war.

Since the reader would find it an excessive labor to look at thousands of photographs, plans, and specimens, which compose the existing history of the Valley of Mexico, the accompanying chart, drawn by William Baake, has been prepared as a digest of the various elements which reflect the history of man in Central Mexico. This article will briefly interpret these data from the conventional historical point of view.

The Copilco-Zacatenco Culture

(Approximately 200 B.C.–400 A.D.)

The earliest people yet discovered in the Valley of Mexico are nameless. While relatively uncivilized in comparison to the Aztecs, yet judged from the broad viewpoint of Indian culture in North and South America, they are by no means primitive. They had several types of well made pottery, the decoration of which showed the beginnings of a sense of design but chiefly satisfied aesthetic yearning in lustrous surfaces and variations in form and outline. Stone and bone tools were competently made, and grinding-stones and mortars attested to dependence on a vegetable diet produced by agriculture. Huts must have been made of wattle and daub, but as yet no complete plan of one has been recovered. Religious beliefs are reflected by the common equipment of the dead with clay vessels and other objects for use in the after life. Chiefly, however, religion coincides with art in the production of many clay figurines, usually female. These may have been used as votive objects or as household images of saints, such as are used in Christian worship today. From these little idols we see that weaving must have been known, since the figures commonly wear elaborately twined turbans. While the form of government and other aspects of social organization remain lost to us, one human activity, trade, may be discovered through the occasional occurrence in the excavations of jade ornaments and shells brought from the south and west of Mexico.

These earliest remains are called the Copilco-Zacatenco culture from the two principal sites where they were found. Speculation as to the identity and tribal affiliation of the makers is fruitless, when there is no mention of them in myth or legend. Yet from the styles and types of their artifacts we can readily distinguish whatever sites they occupied. It is difficult to determine when the makers of the Copilco-Zacatenco culture flourished, but the matter is worthy of some speculation.

Archaeological dating, in the absence of specific written testimony, depends on stratigraphy, the study of the sequence in the ground of layers of human culture. Especially favorable for such research are rubbish heaps, since the objects at the base of an undisturbed midden must be older than those at the top, which were obviously the most recently deposited. One bed of Copilco-Zacatenco refuse attained a depth of twenty-five feet. By carefully peeling the strata, it was possible to distinguish five successive styles of figurines evolving one from another. It must have taken several centuries for the ordinary household débris of a village to accumulate to such a depth, and the evidence of artistic development involving the slow gradual evolution of an unadvanced culture confirms this impression of a long lapse of time. A very rough comparison of this accumulation with another dump in New Mexico of known duration suggests the passage of some five or six centuries.

THE CUICUILCO-TICOMAN CULTURE

(Approximately 400-700 A.D.)

The Copilco-Zacatenco culture, just described, ended abruptly. It was replaced by another culture with new pottery styles and figurines, the makers of which were distinguished from their predecessors by a slightly different physical type. No tribal name individualizes these new-comers, so that the selection of a distinguishing term, Cuicuilco-Ticoman, was based on the type sites where this culture was discovered.

The craftsmanship of the Cuicuilco-Ticoman culture was superior to its predecessor. Sculpture, to judge from the little clay figurines, showed considerable anatomical fidelity and pottery decoration is characterized by a greater capacity in design. However, various culture traits imply an intellectual advance and the possibility that this culture contained the germs from which grew the great theocracies so characteristic of Mexico. For example, several idols of stone and clay represent a specific divinity, the Fire God, who plays an important part in later theological conceptions. Previously in Copilco-Zacatenco times, there had been no visible attempt to differentiate formally the various divinities. Ceremonial architecture, like the great oval mound at Cuicuilco, and other mound sites in Puebla and Morelos, attest to a centralized government, probably priestly, which could control and direct the tribal activities.

Whereas the preceding Copilco-Zacatenco culture seems relatively restricted to the immediate vicinity of the Valley of Mexico, Cuicuilco-Ticoman is more widely spread, extending into Morelos and Puebla and as far east as Vera Cruz. Local styles indicate that there were probably several separate tribal entities within the wider culture group.

Dating the cultures

The element of time is baffling and complex. In the Valley of Mexico we know from the evidence of stratification that the Cuicuilco-Ticoman culture supplanted the previous one. There is evidence in Morelos that the culture existed in a crude and early form contemporaneously with Copilco-Zacatenco. Presumably then the Cuicuilco-Ticoman complex after attaining a certain cultural level invaded the Valley from outside and driving out its previous occupants held it for themselves. Trade pieces from the succeeding Toltec civilization, which shows strong indications of having originated in a branch of Cuicuilco-

Ticoman, suggest a partial overlap. Therefore since the great Toltec site of Teotihuacan is supposed to have been founded around the beginning of the eighth century, we have a rough terminal date. Stratigraphy shows three time phases disclosed in rubbish beds a third to a half as deep as the Copilco-Zacatenco middens. Thus if we allow three centuries for the later culture and six for the earlier we arrive at the rough approximation of 400-700 AD for the duration of Cuicuilco-Ticoman and 200 BC to 400 AD for Copilco-Zacatenco. A confusing factor is the presence of a lava flow which surrounds the Cuicuilco Mound, and suggests great antiquity. However, as there is no good internal means for dating lava flows, it is safer to place this one as late on the basis of the material beneath it, than to make a wild shot in the dark at the age of the flow and ignore the archaeological evidence.

THE TOLTEC CIVILIZATION

(700-1100 A.D.)

The next group to occupy the Mexican scene are the Toltecs, who bear the name given them by the wild tribes who supplanted them. There exist also traditional accounts distorted by myth that elucidate certain events of that time which ended in disasters produced by drought and the invasions of wild tribes. The clearest picture of Toltec civilization is given by the visual elements existing at the archaeological sites of Teotihuacan and Azcapotzalco, which tradition ascribes to the Toltecs.

Using the same criteria (pottery, stone, and architecture) that we used for our estimate of the rather drab cultures of Copilco-Zacatenco and Cuicuilco-Ticoman, we find evidence of a great material and intellectual advance. Pottery divides itself into well made vessels for domestic use and ornamental vessels for service in rituals, which carry complex designs involving theological symbolism. Sculpture progresses from simple beginnings in the Ticoman styles to sophisticated presentations of human beings and grotesque divinities. The mold was introduced at this time so that votive objects could be standardized and contribute thereby to a more rigid observance of ritual. Stone sculpture was developed to the point of carving decorative friezes in high relief as well as massive figurines of heroic size to symbolize the gods. One of the frescos that has survived shows an elaborate ceremony where ornately garbed priests make burnt offerings to massive idols.

Social organization seems to show the same advance manifested in the material culture. A government, presumably priestly since the emphasis everywhere is on religious symbolism, was sufficiently well organized to induce the people to rear a sacred city, laid out not only according to plan but also according to elevation, to judge from the harmonious grouping of temples and platforms of various heights. The spacious disposition of rooms in the residential structures indicates that living conditions had improved, at least for the ruling class. Religion gradually became transformed from an unspecialized direct worship of two or three major divinities to a highly specialized ritual involving many grades of priests to serve a number of gods with carefully defined functions. In design, a rich symbolism suggests if not a system of writing at least the beginning of one, and there is even some evidence that the ritual calendar so characteristic of Central American civilization was in use. Finally the far flung sites where material of Toltec type is found, indicate a cultural dominion over a very wide territory.

Tradition as we have seen ascribes the fall of the Toltecs to a prolonged drought followed by the invasions of wild tribes sometime into the twelfth century. Certainly there is no evidence at Teotihuacan of anything so sudden as a siege followed by a raid of the sacred city. The wild tribes must have filtered in very gradually since there are tales of the newcomers marrying Toltec women and absorbing the local culture. Yet many Toltec towns must have survived after the collapse of the principal city. The archaeological evidence at Azcapotzalco discloses a late period not found at Teotihuacan, where there was a rich if decadent culture, suggesting that long twilight of the Roman Empire found in the Byzantine civilization.

THE CHICHIMEC PERIOD

(1100-1350 A.D.)

Historical tradition which tells of the intrusion of the wild tribes to bring an end to the Toltec dominion, is sustained by the archaeological evidence. Overlying many Toltec sites one finds pottery and figurines which by their heterogeneity in shape and design suggest the presence of various tribal groups. In fact in many cases there is a precise correlation between the tribes mentioned in the chronicles and the pottery types found in the regions occupied by these peoples. The traditional date for the dispersal of the Toltecs and the coming of the migrant peoples in the twelfth and thirteenth centuries is confirmed by trade pottery which also appears in sites of the same period in Yucatan.

Previous to the twelfth century the various groups seemed to participate in a succession of common cultures culminating in the Toltec civilization. After this time we enter a period where highly specialized local cultures suggest a complete lack of political unity, an impression borne out by the tribal traditions which describe an infinite succession of petty wars. In the early part of the fourteenth century various new groups are reported to have entered the Valley bringing with them a knowledge of writing and the worship of Tezcatlipoca, the chief god in the Mexican pantheon. Coincident with this sudden entrance of civilization, the political picture changes. By the middle of the fourteenth century two great city states, Azcapotzalco and Texcoco, succeeded in dominating their neighbors and mutually contested the hegemony of the Valley.

THE AZTEC PERIOD

(1350-1520 A.D.)

The situation became like that in modern Latin America, where people partaking of a common culture and speaking a common language strive for political dominance. The native histories, in which improved proficiency in writing enable the student more exactly to follow political events describe in great detail the struggle between the brute strength of Azcapotzalco and the cultured guile of Texcoco. By the end of the fifteenth century the former had emerged victorious.

At this point the Aztecs appear on the scene as a political power. For nearly a century they had been a poor and insignificant tribal group. In the first quarter of the fifteenth century they seem to have instigated a general revolt against Azcapotzalco, inducing not only lesser towns like Tacuba but even the shattered power of Texcoco to take arms against the oppressor. They won a signal victory and with their allies extended their dominion year by year until shortly before the Spanish Conquest in 1519, they received tribute from all of southern Mexico as well as Guatemala and the Vera Cruz coast plain.

We have abundant information on the Aztec civilization from the first hand accounts of Spaniards, and Spanish-educated natives. The economic and social life of the people was focused on religion. All life centered in the nourishment and placation of a complex and numerous group of gods. The priests being spiritually in closer kinship to the divinities not only led in sacrifice and fasting but also instructed and controlled the civil population in the performance of their duties.

Religious calendar

Although infinite subdivisions of class and trade took place in the civil population as their culture grew more complex, the religious ritual expanded to control these new developments. The calendar or sacred almanac was an effective means for this domination of religion over civil life. Every day and every night was under the protection of one or another of the various gods and goddesses who had to be appeased. Special gods presided over the weeks and months. So completely were the people governed by the calendar that at the completion of their cycle of fifty-two years, a large unit of time corresponding to our century, they thought that the world might end if the gods were not sufficiently propitiated to renew life again.

Before the new year, all hearths were extinguished, all household utensils broken and discarded, the people gave themselves up to fasting and lament. The priests repaired to a high hill just outside of Mexico City and made sacrifices. When the gods signified their approval, at dawn of the New Cycle, a new fire was kindled in the heart of a sacrificed slave, and runners with torches lit from this blaze ran to light again the hearths of temples and houses in every part of the Valley. Great rejoicing arose, and the people redecorated their homes and temples, made new household furnishings, and were ready to enjoy the life secured then for another fifty-two years.

Many writers have called attention to the drama of the custom but it has a very strong archaeological significance as well. This wholesale destruction of property at the end of the old cycle must have left enormous accumulations in every village. In various excavations in the Valley we have found deposits of broken pottery that appear to be the result of mass breakage and not the gradual accumulation of material discarded in the course of everyday life. It seems perfectly logical to identify these dumps as the result of cyclical destruction. Moreover the practice of successively enlarging temples may result from the renovations undertaken at the birth of the new cycle.

It is feasible, therefore, to correlate archaeological styles with these cyclical destructions and renovations and thereby arrive at an absolute instead of a relative dating for Aztec culture periods. With the aid of stratigraphical data from ordinary middens, it was possible to isolate the dumps emanating from the New Fire ceremonies of 1507, the last ceremony before the Conquest in 1519, of 1455, and of 1403. The Mexican excavations at Tenayuca revealed five renovations of a temple, that might be correlated with the cyclical rites of 1507, 1455, 1403, 1351, and 1299. The internal evidence of types and styles seems to substantiate the hypothesis. Material from the dumps of 1455 and 1403 is rare in Tenochtitlan, the ancient Mexico City, whose importance was relatively insignificant during that period, but is especially common in the region controlled by Texcoco, the dominant center at that time. A change from non-Aztec to pure Aztec architectural style at Tenayuca corresponds to the renovations of 1351, when Aztec culture began to flourish during the era of the final unification of the Valley.

Progress

Thus we have evolved a finely graded instrument to compare the visual information gained by excavation with the textual history of the documents. Instead of an impression of a land torn by intensive strife as set forth in the chronicles, we see through archaeology a steady cultural advance. Houses become successively larger and more logical in plan. Temples grow in size and majesty. Sculpture becomes more skillful. The ceremonial carvings and frescos reflect the increasing complexity of the theology, until we can visualize the abstruse developments mentioned by the historians. In the refuse heaps we find more kinds of things made in more varied ways. Dumps of towns under Texcocan domination produce finer objects than do those of the Mexico City Aztecs, exactly reflecting the historical position of the Texcocans as an older, more civilized and better established group than the Aztec who were militarists, only in later times able to enjoy the fruits of civilization. In one style of pottery it seems possible to see a dim reflection of the national state of mind, epistolary designs at the time of the introduction of writing, formal ornateness at the renascence of Texcocan dominion, coarse conventionalization during the period of political expansion, and finally the totally new conception of naturalism when the Valley tribes settled down to enjoy the fruits of Conquest. Especially significant are the abundant trade wares attesting to commerce and the tributes wrung from subject tribes. The conclusion one reaches is that human culture in the Valley of Mexico continued to progress during the fourteenth and the fifteenth centuries, in spite of bitter political struggles. Indeed were one to study the history of Europe and the United States with personalities and national situations erased, there would likewise appear an orderly and brilliant ascent to successively higher levels of civilization.

Archaeological research in Mexico stops with the Spanish Conquest. It is tempting to think of using the spade to evaluate the later phases of Mexican history, during the Colonial Period, the Republic, and the modern era of increased mechanization. Perhaps then we would be able more fully to formulate the nature of the data acquired by archaeological research. We can see the development of civilization and the fruits of human activity, but the actions of individuals and tribal groups are conspicuously absent. Yet the impression remains that, even if perfection demands the presence of the individual in the pages of Mexican Indian history, it would mean adding to the present record, not changing it. One is tempted to enunciate the heresy that human progress does not depend on political parties or economic creeds, but rather on the continuous effort of mankind to dominate nature and to develop a life worth the cost of living it.

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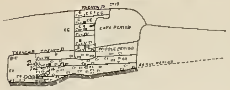
The History of the Valley of Mexico

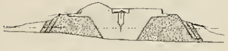
Archaeology must be seen, not read. The four panels represent the successive stages of Mexican art, during the Archaic, the Toltec, the Chichimec, and the Aztec phases. During the Archaic Period (approximately 100 B.C.-700 A.D.) writing was unknown and architecture little developed so that cultural studies must depend on pottery and figures. In the Toltec Period (approximately 700-1100 A.D.) formalized architecture begins; but not until the Chichimec Period (approximately 1100-1325 A.D.) are there historical records of value. The Aztec Period (1325-1520 A.D.) is fully documented and it is possible to compare the documentary with the archaeological evidence. It is through the study of the styles of architecture, pottery and sculpture that the archaeologist must base his historical conclusions on Central American archaeology.

Drawings by William Baake

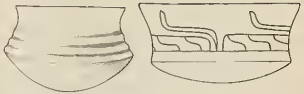
PANEL I
Archaic Cultures
(about 100 B.C.-700 A.D.)



Section of a rubbish heap at Zacatenco, in which may be studied the succession of cultures. There were no written records at this time

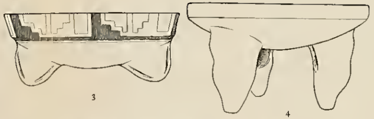


Section of the oval mound at Cuicuilco. The interior is of adobe and the exterior faced with stone



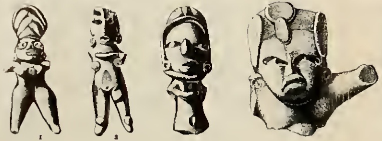
1 2

Nos. 1-2 are vessels of the Copilco-Zacatenco culture, the earliest yet discovered in the Valley



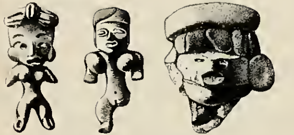
3 4

Nos. 3-4 are pots of the later Cuicuilco-Ticoman horizon. Note the use of tripods and painted design



1 2 3 4

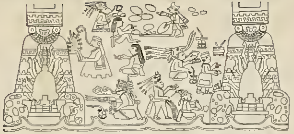
Nos. 1-4 represent successive stages in the evolution of the figurine at Zacatenco



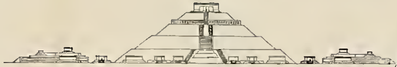
5 6 7

Nos. 5-6 show earliest and latest types of the later Ticoman figurines No. 7 An early Toltec figurine which may have evolved from No. 5

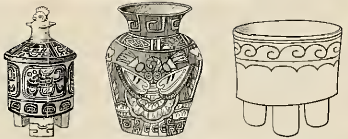
PANEL II
Toltec Civilization
(about 700-1100 A.D.)



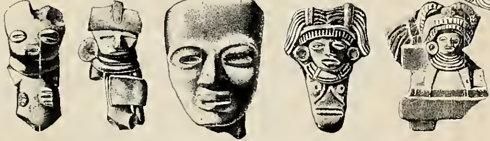
Fresco from Teotihuacan showing a Toltec ceremonial. Note the male and female figures making offerings to the idols, before which fires blaze on the altars



The Pyramid of the Sun and surrounding temples at Teotihuacan. Note the majestic character of this religious monument

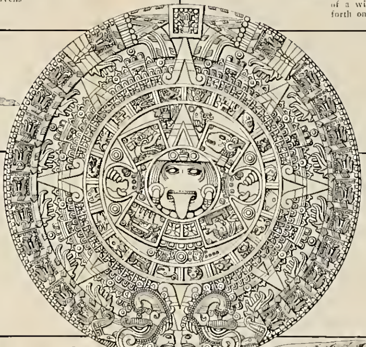


Pottery vases, Toltec. Rich decoration and symbolism mark the first two vessels. The third shows degeneration in design at the close of this epoch



Stages of Toltec sculpture in clay. The first two figurines show affinity with the archaic technique in the first panel.

The third figure shows great skill in modeling and the last two mold-made pieces represent the plastic of the last phases of Toltec art



The Aztec Calendar stone in the center of which is represented the Sun God. The encircling bands describe the days of month and other calendar signs. This stone symbolizes the sacred nature of time and the heavens

1

Scenes from picture records: No. 1 sh
of a wild hunting tribe. No. 2 disclos
forth on their wanderings which end

1

Reconstruction of
No. 1 is the origi
the renovation of

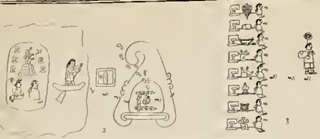
1

Each tribe at th
No. 1 Mazapan

1

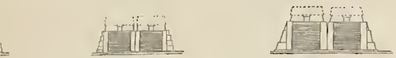
Figurines of the Chichimec Period wi

Panel III
The Chichimec Period
(1100-1325 A.D.)



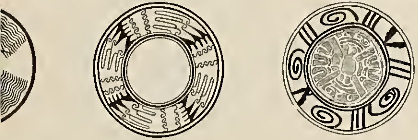
s a representative the Aztecs setting ally in the Valley.

No. 3 shows some of the tribes each with its identifying symbol, which supplanted the Toltecs and founded city states in the Valley



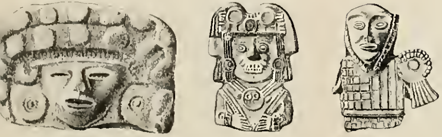
stages of the Temple at Tenayuca building. No. 2 the building after 19. No 3 the reconstruction of 1351

where it takes the form of the regulation Aztec buildings in the next panel



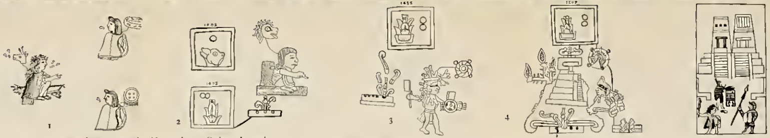
ime made its own type of pottery. pe perhaps made by the Acolhua.

No. 2 Coyotlatelco type perhaps made by the Tepanec. No 3 Culhuacan (Aztec I) style of the Culhua



crude but variegated Nos. 1-2 are Coyotlatelco, Nos. 3-4 are Mazapan in typ

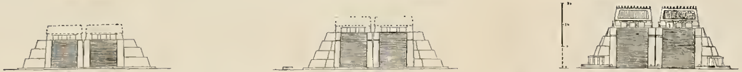
Panel IV
Aztec Period
(1325-1520 A.D.)



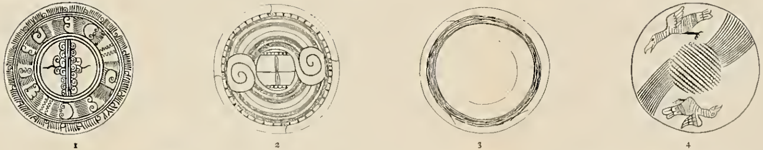
Scenes from picture records: No. 1 shows Quinatzin, ruler of Texcoco, receiving the tribes who brought the knowledge of writing in 1325. Each bears his identifying symbol

No. 2 Notable, with year signs and symbols for the New Fire ceremony of 1403. No. 3 The New Fire ceremony of 1455. No. 4 Record of the New Fire ceremony of 1507.

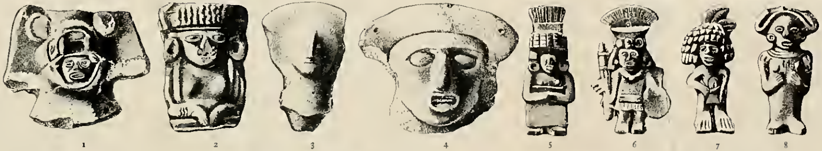
Note the captured temple and designation of eclipse and earthquake. No. 5 The conquest of Mexico in 1519 as seen by an Aztec scribe



Successive stages of the temple of Tenayuca after the renovations of 1403, 1455, and 1507. Note the massive size after the final reconstruction



Nos. 1-3 Aztec bowls from the cyclical dumps of 1403, 1455, and 1507 No. 4 naturalistic design from Aztec bowl made after 1507



Nos. 1-2 Mazapan figurines. Nos. 3-4 Aztec figurines of the fourteenth century. Nos. 5-8 Aztec figurines of the fifteenth century representing gods and goddesses. Compare the crude style of the clay figurines with the masterly execution of the Calendar stone, 13 feet in diameter.

Rolling Down to Mexico

A journey in photographs, by Charles Coles, Staff Photographer of the American Museum, in which NATURAL HISTORY Magazine blazes the trail pictorially for motorists who covet the varied charms of a foreign country. Such a trip was not possible until the 763-mile road from Texas to Mexico City was thrown open to American tourists last July

WELCOME TO MEXICO: *the inevitable customs inspection is thorough but courteous. Porters, subsisting only on the tips you proffer, handle your luggage. On the left, the Immigration Office and on the right the Customs*

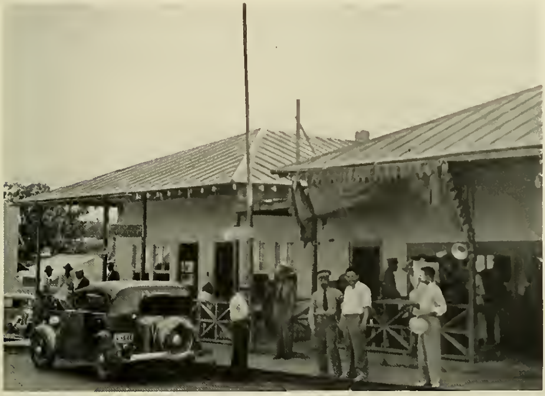
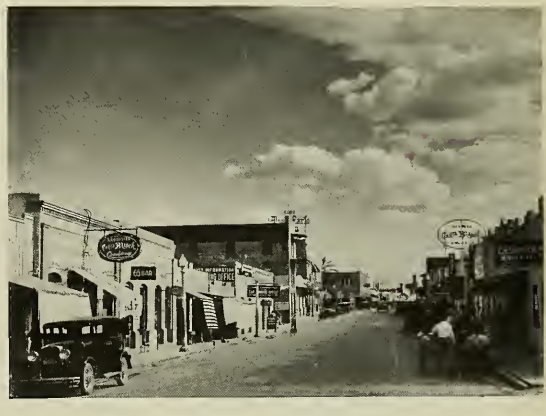


Photo by W. Henschel



NUEVO LAREDO, WHERE THE ROAD BEGINS: *as you travel down this street the sharp contrast of the low Mexican buildings to the comparative skyscrapers of the American Laredo strikes the traveler immediately*

Photo by W. Henschel

TOURIST CAMP, MEXICAN STYLE: *these splendid accommodations are at Monterey, 148 miles south of Nuevo Laredo*

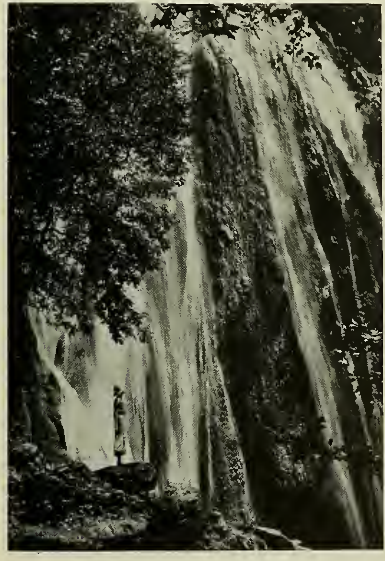
WEIRD SILHOUETTE: *Yucca trees stand against the desert sky, along a fine paved road continuing south of Nuevo Laredo. Voices span the desert in a twinkling through the wires seen over the tree*

DEPARTURE AT DAYBREAK: *this view through the palms at "Apartementos Regina para Touristas" greets daybreak risers starting early on the next lap of the trip*

A HALF HOUR FROM MONTEREY: *the Ranch of the Beautiful View repays a side trip over this road to the mountains*

Photo by W. Henschel

"THE BEAUTIFUL VIEW" *refers to the splendid Horse-tail Falls which pours down the mountainside into a valley of tropical luxuriance. This falls was characterized in one guide book as "over-rated"*



HOTEL AT VICTORIA: *the second night may be spent in this hostelry. The cars are parked in the patio around which the rooms are grouped*

RELIC OF SPAIN'S CONQUEST: *as you leave Victoria, you will see this church which is claimed to be over 400 years old*

REFUEL BY FUNNEL: *stopping for gas at Valles, you will be surprised at the variety of odd-shaped funnels used to pour gas into your tank from a ten litre measure. Gas pumps are not trusted*

CROSSING THE TROPIC OF CANCER: *thirteen miles south of Victoria, you pass into the tropical zone. Close to this point you rise to the top of the Mesa de Llera for a sweeping panorama*

A DELAY: *just beyond Valles travellers formerly had to take a "siesta" while waiting for a ferry. The hot tropical sun can be mighty uncomfortable without the shelter of palm leaves*

POWERLESS CONVEYANCE: *this primitive ferry was propelled across the river by the action of the current against the sides of the raft. A steel bridge now spans the river*

ANIMAL LIFE ABOUNDS *in the palm forests stretching to the horizon from each side of the road. The motorist gets some idea of the dense jungle through which the road was built*

"THOMAS AN' CHARLIE" *(common name for Tamazunchale) will probably be your next night's stop. If you stay at the Hotel Vega you will have this view from your room. The small building is in the patio of the hotel and is the home of the owner, Señor Vega*

GRACEFUL WOMEN *of the Huastecan Indians, as seen from the Cafe Royal in Tamazunchale. The natives had never seen an automobile before the building of this road*

CLIMBING MOUNTAINWARD: *as you leave Tamazunchale at an altitude of 500 feet, the road rises steadily, following the Rio Montezuma*

ABOVE THE TROPICS: *fields, planted by Indians suspended by ropes from trees make a patch-work of yellow and green on the steep slopes. The road has now climbed to an altitude at which temperate zone plants will grow*

CUT THROUGH SHEER ROCK: *here the road is at an altitude of 7500 feet, where occasional landslides make maintenance difficult*

BLANKETS OF CLOUDS *are formed on the cool heights by the warm moist air which rises from the tropical lowlands. Magnificent views charm the motorist at every turn in the highway*

JACALA, END OF THE MOUNTAIN ROAD: *when this little town appears, you will know that it is only 163 miles to Mexico City, over a fast, paved highway*

THE HIGHEST POINT OF THE ROAD *(9000 feet), although beyond Jacala, is passed over so easily that it is hardly noticed. The country again takes on the character of semi-aridity where cacti flourish. You are now in the Valley of Mexico*

FOR THE FIRST TIME IN HISTORY *the motorist can step out of his car in a foreign metropolis. Mexico City, once the Aztec capital, is a modern city, yet at every turn are reminders of its ancient past*

Bird Courtship

Do the male's fine feathers attract the mate he wishes to win? Observations which question the adequacy of Darwin's theory of sexual selection

By H. N. SOUTHERN

PERHAPS no other aspect of Darwin's work has been criticized so much as his theory of sexual selection. Chiefly it points to the advantage of bright plumage in male birds in the mating contest, and offers an explanation why in so many species the male is brilliantly adorned while the female is dull. The individuals that are most brightly colored have the greatest success in securing mates, according to the theory of sexual selection, with the result that the brilliant features are transmitted to the offspring in greater and greater degree.

Fine feathers

While this theory has been applied principally to birds, some fishes and arthropods and even a few of the higher vertebrates have characters which point in the same direction. On the face of it the theory sounds quite reasonable and explains a number of things in the bird world which are mysterious upon any other hypothesis. The elaborate visual display of the peacock and equally the complicated antics of dull-plumaged birds like the Old World warblers seem to answer to no positive purpose that would improve their chance of survival, unless to that of appealing to the discrimination of the hen bird. Far from being of value in the struggle for existence, the peacock's tail must be a positive burden to him, and if there were no counter-acting factor, birds with such a senseless over-development of one of their organs would be speedily weeded out.

If it is accepted that the elaboration of color, form, and movement is critically appreciated by the females, and that they choose those mates which by a greater riot of color or a greater abandon of posture can stimulate them to successful mating more readily, then it will be clear that the hereditary factors for these characters will be handed on to the offspring more frequently than others.

While there is no doubt that sexual selection can actually be discerned in operation in certain cases (the observations by Edmund Selous upon the courtship of the ruff are convincing enough for all but the most captious critics), there are a number of difficulties that arise. Many instances are recorded of cock birds with poor plumage getting mates while more brightly colored competitors are condemned to bachelorhood. The hen in many cases seems to be quite oblivious of the display that is going on and seems pointedly to look the other way. This is curious if the stimulation is by a visual image. Again it would seem to be equally important for the future of the race that the hens should also undergo a form of selection since they contribute half of the hereditary factors of the next generation. Eliot Howard has shown that in the warblers at least the possession of a territory is a more important factor in securing a mate than an elaborate display.

Chance observations

As with most zoölogical controversies the correct answer seems to be a compromise, an acceptance of the fact that sexual selection has been seen to occur with the proviso that many other factors may be equally if not more important. There is much still to be learned about courtship and display before we can dogmatize, and this material can only be collected by painstaking and co-operative observation. If only there were a way of collating the various facts that are known, we should have progressed some way: so many people who are out hunting for something entirely different, drop across some incident of importance, though they do not know it, and the information remains locked in their heads or reported in parenthesis in some quite unsuspected journal. If we could only organize it, there must be quite a large body of facts to draw upon.

As a member of an ornithological expedition to the Shetland Islands in the summer of 1935, I was able quite accidentally to record several observations of interest upon bird courtship, though the purpose of the expedition had not been connected with this at all. It only shows how anybody may come across information in the most unexpected way, which should be made known.

Birds on the Shetlands

The Shetlands are a barren group of islands lying at the extreme north of the British Isles about 55 miles northeast of the Orkney Islands, and the capital town of Lerwick is situated almost exactly upon latitude 60° N. The coast line is everywhere rocky and precipitous and supports a tremendous population of sea birds. Two species of skua are fairly common there, the great skua, or bonxie, as the Shetlanders call it, and the smaller Arctic skua (better known in America as the parasitic jaeger), which both live in a piratical manner by chasing the various sea birds and compelling them to divulge the cargoes of fish that they are carrying back to the nesting ledges.

In making a survey of one small island on the east side of the mainland we noticed that the bonxies tended to collect upon one particular ridge about half way up the moorland slope that formed the main part of the island (there are no trees in Shetland, and so the bird population is entirely ground or cliff nesting). Having a day or so to spare we decided to spend some time watching what was going on at this "club," and after a few hours we found that events were so interesting that we put up a "hide" and managed to take some photographs of the proceedings. It was one of the most pleasant places we had ever been in to make bird observations, and one's attention was continually being distracted, if one was not careful, to the splendor of the surrounding scenery. The island rose steeply in its short breadth of a mile and a half to 600 feet, so that even from this ridge most of the southeast part of Shetland stretched out before us penetrated by sinuous fingers of blue water. In fact so broken up is the coast line, that no part of the islands is more than three miles from the sea.

Courtship of the bonxie

The books informed us that the courtship of the bonxie consisted of mutual wing-raising by both sexes, displaying the white webs of the proximal part of the primaries and flashing them into view as a sort of surprise, as do so many birds with hidden patches of color in their plumage. What puzzled us was that this could be seen going on all over the nesting colony, and did not appear to have any special courtship significance. It was used for greeting, for remonstrance when one bird intruded into the territory of another, and as a general expression of excitement or self-assertion. Observations on the ordinary nesting territory did not seem to give us much information as to the real courtship, for surely this was only a poor pretense at it. Apart from that, of course, the hillside was exciting enough on account of the bonxie's habit of stooping at intruders. It takes a certain amount of self-control not to duck automatically when these great brown birds with a wing spread of five feet or so come hurtling straight at one, but almost without exception they check upwards when they are about two or three feet away from the object of attack. They look so terrifying with their big heavy bodies, and when seen soaring in the sky are curiously reminiscent of eagles with their great wide sails of wings.

But to return to the ridge: we found that after we had settled ourselves down in the heather at a point of vantage, birds would begin to return in ten minutes or so, all making for this one particular spot out of the whole island. One small patch of it was worn absolutely bare of herbage by the feet of countless generations of bonxies. Each new arrival would be greeted with upraised wings and a hoarse call by at least one of those already present and sometimes the emotion would communicate itself to a number of them.

Several of them were sitting in obvious

pairs, and of these one especially was very active, the female brooding on an imaginary nest with great solicitude, while the male stood by her and raised his wings at the slightest provocation. Soon she stood up and the two birds stood breast to breast calling and wing-raising. This happened several times and fizzled out, but finally the male started to adopt entirely different tactics: he puffed out his neck feathers until they looked twice the normal thickness, and strutted with head in the air in front of the female. Up and down he went in a kind of sentry-go, until the hen who was standing up and calling reciprocally at first finally sat down and mating was accomplished. On several occasions we saw this procedure end with the refusal of the female to take part and the male was driven off. On every occasion that we watched, these activities were constant, though it should be remarked that a number of the birds present at the gathering (sometimes between twenty and thirty were seen out of a total breeding population for the island of 60 pairs) seemed to be males whose mates already had eggs on the nesting ground nearby.

The interesting thing is to find that the courtship of the bonxie is not after all a mutual affair, as one would guess from a superficial knowledge of their activities (i.e. the wing-raising) and from their close relationship with the gulls, but one in which the male has a definite display of his own. The question as to whether the birds who can strut the best are sexually selected is, one feels, rather doubtful, and the whole complex behavior of the bonxie at this time of year needs more thorough investigation. The noticeable social atmosphere in a bird which is bold enough not to need the safeguard of flocking, is one of those elaborate conventional patterns of behaviors that one finds among birds that exhibit more than the usual care of the young, and may form a sort of bond of a psychological nature to keep the parents, as it were, "interested in their job."

Love-making of other birds

The probable significance of the wing-raising and calling with open beak as a primitive feature of the bonxie's courtship was made more probable to us by observing the love-making of several of the other sea birds that nest in Shetland. Certainly one of the most interesting of these is the fulmar petrel, twos and threes of which were always to be seen performing their antics on any raised surfaces which gave them opportunity to land. The accompanying photographs were taken at the peat stack just outside the house which served as our headquarters. Admittedly there is a great deal that is mysterious about the fulmar's behavior, but the main principle is obvious enough. Two birds sit close together, straining their beaks forward and calling with a guttural "kuk-kuk-kuk-kuk-kurrrrrr," at the climax of which the head is twisted and waved about so that the mauve-colored interior is suddenly displayed. Here is a clear case where stimulation is completely mutual, and presumably the birds that can produce the best reaction upon each other will be the most successful breeders. If we are true Darwinists, we shall make an extention and call this "intersexual selection," and argue that the bright colors of the inside of the mouth in many seabirds have been produced in this way.

Not the usual triangle

Again, however, the case is not half so simple, and our interpretation of the fulmars' behavior was constantly being complicated by the arrival of a third bird who would join the party and perform just the same actions. If it was a case of simple one-sided selection, we might be tempted to think that two males were contesting for the female, but in cases even where one of the three birds was incubating, these three-cornered performances would be observed going on, and the whole thing seemed to take on more of a social significance. In addition there is the fact that this kind of business is seen quite late in the summer, and we have a state of affairs closely resembling the "piping parties" of the oyster-catcher, which occur when breeding is finished.*

Thus it may be concluded that, though sexual selection may be valid to a certain extent, it does not go deep enough into the problem of bird behavior by a long way, and it is quite impossible to explain complicated emotional situations by such a simplified and single explanation.

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*Attention is called to a series of photographs illustrating the "dance" of the Laysan albatross published with an article by Homer R. Dill in the April, 1913, issue of NATURAL HISTORY.

Bird Courtship

(Top) A stern and rock-bound tryst: fulmar petrels engaged in vocal courtship

(Center) Promenade of a gallant: puffing out his neck feathers, the male bonxie struts importantly in front of the female, a phenomenon supporting the Darwin doctrine

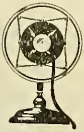
(Below) Greetings, my feathered friend! Wing-raising is a social salutation as well as a courting gesture, among the bonxies

★

THE INDOOR EXPLORER

By D. R. BARTON

CRICKET ON THE MICROPHONE: Visitors walking among the insect exhibits on the third floor of the American Museum, will have their curiosity aroused by peculiar trilling sounds which apparently emerge from a darkened corner of the hall.



If these visitors happen to have what the psychologist calls "good associative dispositions" they will probably be reminded of summer evenings when they lolled comfortably in screened porches, lazily conscious of the incessant chirping crickets in the yard outside. That is exactly what they are listening to.

They will follow the sound until they reach an illuminated glass case housing several chubby crickets.

Now, these insects are not being given sanctuary from the winter frosts without a purpose. Inside their glass home is a microphone which is connected to a large amplifier or loudspeaker outside and above the "show case." This apparatus, which was devised by Mr. L. W. Holden, projectionist of the Museum's education department, makes the chirping of the crickets clearly audible to the visitor. Why? Not simply to stimulate pleasant summery recollections to tide him over the bleak winter. The real purpose is to acquaint him with the cricket at close range, and to show him how the cricket actually makes his chirp.

Fox Movietone News recently made a sound film of the cricket, thus presenting him for the first time on the screen. The Museum considers it a privilege to sponsor, what may be called his first "radio" broadcast, as well as his debut on the legitimate stage.

How he chirps

Only adult male crickets can chirp. The female of the species, easily recognized by the slim, needle-like "tail" with which she pierces the ground when laying her eggs, is one of the most reticent of her sex in all nature, and she rears her children in the best traditions: they are seen but never heard.

The reason for all this is quite simple. Immature crickets cannot chirp because they have no wings, and adult females cannot chirp, because, although they have them, their wings are not equipped with the male's chirp-making "musical file." Yes, the male cricket chirps with his wings.

Near the front of each front wing of a male cricket, is an enlarged rib or brace. On the under side of this rib is a series of small teeth. Then on the upper side of each front wing is a small rough spot so placed that when the wings are rubbed together, the teeth on the underside of one wing scrape on the rough spot that is on the upper side of the other. This rubbing of a file-like structure on a rough spot starts both wings to vibrating very rapidly, probably at a rate of not far from 5,000 shakes per second. This rapid vibration of the wings up and down as the male cricket rubs them against each other from side to side sets the air to vibrating in waves of such a character and frequency that our ears recognize a shrill sound or chirp.

From a microscopic study of the delicate lines on a "sound-film" recording of cricket's chirps, the Museum's department of insects has found, among other things, that (1) The cricket chirps, so far as its fundamental notes are concerned, in the octave just beyond piano range. (2) Such a performance would, in musical terms, be called a beautifully executed "slur" such as would be possible for an expert violinist, except that the cricket does it in less than 0.03 second, and then in less than 0.02 second repeats it almost exactly.

Probably the first definite sounds made by land animals on this earth were made by insects. Before ever birds sang or even frogs croaked, insects had developed a chitinous covering, the segments of which, rubbing together, produced sound-waves. Whether these sound-waves were audible in the sense that there were organisms with nervous mechanisms attuned to them might be the subject of an interesting speculation.

ARTIFICIAL DEFORMATION OF SKULLS: Today, the prevalent and extensive use of cosmetics has come in for a good deal of criticism by our elders. Die-hard conservatives have waggled many a reproachful finger at the modern woman's "war-paint," although its defenders regard it as a phase of "the more abundant life."

Whatever your stand on the issue, you will be interested to know that this modern instance of cosmesis, (the art of improving and preserving natural beauty), is mild in the extreme when compared with primitive practices in general and the deformation of the head in particular.

The custom of deforming the cranium is shared by many peoples distributed over a world-wide geographical area. It flourished in Peru, among the Indians of Southwestern United States, in several Pacific islands and in certain localities in Asia. It is usually a conscious attempt to emphasize an ethnic conception of beauty by directing and inhibiting the growth. The figure above shows the result of a distortion, carefully nurtured from infancy, on the head of a North American Indian. It should be remembered that the heads of male children were treated in this fashion quite as much as those of the females.

Dr. Harry L. Shapiro, Associate Curator of Physical Anthropology at the American Museum, observes that, "The crania which are classed as artifically deformed range from those so slightly affected as to escape notice to forms which are startlingly fantastic. The methods of deformation vary similarly from simple cradle board and bandages to elaborate machines which have all the diabolical appearance of medieval instruments of torture. The facial parts of the cranium are relatively less influenced by deformation than the cranial vault. Also it does not appear that deformation has any generally noticed effect on intelligence or the capacity of the cranium."

Dr. Shapiro has devoted much time to the problem presented to the anthropologist by deformed skulls recovered in excavations.

Due to the artificial formations the skulls are very difficult to classify, and lead to erroneous conclusions. To surmount this stumbling block, Dr. Shapiro has developed a formula which enables the anthropologist to calculate the exact proportions that would normally have characterized the skull, if it had not been subjected to the beautifying treatment.

There are several instances among Europeans where cosmetic customs have deformed the skull quite by accident. The celebrated paintings of the Dutch masters often portray the voluminous coifs and head dresses in vogue at their particular period. Investigations have disclosed frequent cases of cranial distortion clearly the result of the tightly bound fastenings of these contraptions which were worn from early childhood. We may conclude then, that the woman of today is not nearly as thorough a spartan as her ancestors or her primitive sisters in the matter of personal vanity, and that the masculine element of our present civilization is even less amenable to the ancient ordeal of adornment.

Your New Books

A Jungle Laboratory—New Guinea Art—African Safari—A World of Errors

SKYWAYS TO A JUNGLE LABORATORY—AN AFRICAN ADVENTURE

- - - - - - - - - - - - - - - by Grace Crile

W. W. Norton and Co., Inc. Illustrated, $2.75

BOOKS come and books go about Africa and we say when a new one turns up—just another book on Africa.

Many feel (including publishers) that Africa had all been done so there is nothing more to be said.

How far this is from the truth! Africa, more than any other country—for it is still very largely a vast undeveloped land—will remain full of unbounded material for years and years to come.

Africa is forever unfolding new phases of old subjects. And an entirely new Africa is being unfolded to us now that we have the airplane winging its way over this fantastic land showing us things we never saw before and spreading before us still newer wonders.

Grace Crile ably describes all this as she takes us the "new" way over Europe and up the Nile to the very heart of the "Dark Continent." Delightfully and easily written she tells of the thrills, the joys and hard work of a truly great expedition and the part she played in it. As wife of the famous surgeon, Dr. George Crile, head of the Cleveland Clinic Foundation-Cleveland Museum of Natural History Expedition, she accompanied him on this research expedition into the very heart of Africa where she kept the records of the trip day by day and also materially helped in and recorded the results of his scientific findings.

As a keen observer she sees and records also many interesting observations on the codes and customs of the tribes they frequently contact.

She describes vividly the building of their jungle laboratories; how they themselves lived, what they ate and what they all did.

It was a busy camp every minute of the day and often well into the night, as much very important work was to be accomplished.

Her impressions of the country and some of its weird and fantastic scenery is particularly descriptive. Her sensitive nature has endowed her with a gift to see and feel the beauties of this colorful land. And her gift to impart her observations to others has enabled her to produce a worth-while book.

Dr. Crile as the "Chief" heads his fourth expedition into the heart of Africa. Here is a great and prolific biological laboratory where he collects various species of interesting big game not as the many hunters who have gone before him, killing for trophies but for the sole purpose of scientific research that through these findings he may further help mankind.

All this is told in a fascinating manner—the flight over Europe, and the Mediterranean; over Egypt and up the Nile to Lake Victoria and then gliding down to Nairobi. The building of a field laboratory, then the thrills and dangers of getting the desired specimens, and the careful and critical work which followed the preserving, recording and studying of the glands of many strange animals.

Here is a fascinating story of how science ever strives to help us more and how the conservation of big game can serve mankind through science.

JAMES L. CLARK.

ART AND LIFE IN NEW GUINEA

- - - - - - - - - - - - - by Raymond Firth

The Studio Publications, Inc., 381 Fourth Av. $3.50.

THE reader who enjoys visiting art galleries and anthropological collections in museums should find this volume on the native art of New Guinea interesting and useful. There are many fine plates and just enough text to orient laymen and artists in the ways of the New Guinea native. The author is a distinguished anthropologist so his comments can be taken as authoritative. There is a brief discussion of the primitive artist in general in which it is shown that primitive man is primarily a craftsman, interested in making useful objects; his art is merely the aesthetic treatment of such objects, the inspirations for which are drawn from his tribal culture. Finally, the relation between art as illustrated in the book and native village life in New Guinea is properly evaluated. In general, the volume might well serve as a high class guide to museum collections from the same area.

CLARK WISSLER.

ADVENTURES IN ERROR

- - - - - - - - by Vilhjalmur Stefansson

New York

Robert M. McBride and Company

THIS is a series of essays having to do with the old antithesis of truth and happiness. It is generally agreed that the person who insistently questions the accuracy of every popular belief is a social nuisance, so the author is to be commended for his optimism in issuing a volume to prove that most of what the reader has learned about the world is wrong and even silly. For one thing such behavior threatens one's sense of security. However, the reader should not take the book too seriously because most of the time he will be debating whether the author is a humorist or a reformer. The chances seem to favor the former. The chapter on the history of the bath tub is a case in point; everyone should get a laugh out of that.

The author begins by stressing his disapproval of all the debunking efforts leveled at Santa Claus, Washington, Lincoln, etc., but later on he sharply rebukes the living great who have made mis-statements about the arctic; for example Sir James Jeans and Robert Millikan, two great scientists, are shown to have talked nonsense about icebergs and in consequence the author wonders how accurate these great men may be in their own chosen field. There is a long chapter to prove that all the romantic stories about wolves are untrue, that wolves never run in packs and never hurt human beings, except by accident. In this case the reader may not be sure whether he himself or the wolf is debunked.

For the most part the errors discovered by the author have to do with the arctic. He makes the reader feel it a crime to mention a snowhouse because a lot of Eskimos never saw one; to believe that it is terribly cold in their country because there are places in the world where it is sometimes colder; to say there are no trees in the arctic, etc. However, the author's main point seems to be that we live in an unreal world, a world we have built up out of errors and in which we find our greatest happiness.

He thinks that those we regard as distinguished contribute most to the building up of this unreal world and is charitable enough to suggest that he, also, may have had a share in the construction.

He debunks arctic exploration, but believes there will be arctic explorers forever, because people like the romance of the unreal, especially when staged in the arctic of make-believe.

CLARK WISSLER.

YANKEE IN AFRICA

- - - - - - - - - I. H. and Julie B. Morse

Published by The Stratford Company, Boston.
Price, $1.50

Illustrated with snapshots by the authors.

YANKEE IN AFRICA, is a breezy, jubilant book delightfully written, swinging along in easy style recounting in a direct and simple way the reactions, thrills, joys, and at times surprises and even bitter disappointments of a lady on her first and her husband on his second shooting safari to the uplands of the East African game fields.

Mr. and Mrs. Morse, write rather along a personal vein but quite honestly so, for it is frankly as they saw and felt the wonders as they unfolded to them. It is quite the honest reaction of anyone going there and is for this reason refreshing for in reading it one feels himself taking the very trip so buoyantly described.

We follow the Morses over the rolling grassland plains, through patches of thorn bush, into the depths of jungles, seeing quite vividly the many strange animals and brilliantly colored birds of all sizes and hues. We encounter with them the ponderous rhino, the lion, and sometimes a snake, but always with more wonderment than fear. Natives, too, held their fascination and they tell of them as they found them, simple, child-like people but picturesque and colorful in their beads and feathers and magnificent in their deep copper skins and fine physiques.

Their trip was not without a purpose, for not only did they enjoy the Africa which they so ably describe but the specimens they collected were all saved to swell the already representative collection for their private museum which stands at Warren, New Hampshire.

They tell also how this museum, now known as the Morse Museum, was originally started by Mr. Morse as a private trophy room, but his collection became so large and so interesting that they most generously decided to open it to the public that others might enjoy with them these most unique and valuable souvenirs of their wanderings.

Privately maintained and entirely supported by the Morses, the Museum carries on giving joy to many others who are just as interested but not as fortunate and who must be the stay-at-home travelers. The Morses show a fine spirit in that they travel and enjoy the world but not selfishly so, for they in turn are giving it out to others.

We should have more of this kind of people and their kind of books.

JAMES L. CLARK.

PROBOSCIDEA

by Henry Fairfield Osborn

Edited by Mabel Rice Percy

A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World.

Volume I. Moeritherioidea; Deinotherioidea; Mastodontoidea.

The American Museum Press, New York, 1936

THIS sumptuous volume, together with the second one yet to appear, constitutes the final magnum opus of the foremost paleontologist of his time. It represents the fruits of a line of research begun in 1907 and continued through 1935, when its illustrious author rested from his labors. The volume before us has been on the American Museum Press since 1924, during which time the field of research has been greatly broadened and many discoveries have been made which alter the classification of the Proboscidea; the consequent alterations appear in the phylogenetic appendix.

At the time of the author's lamented death on November 6, 1935, the final revision of the manuscript was in progress. This has been carried out along the lines laid down by him; since that time no changes have been made in his determinations and necessary corrections have been inserted as footnotes.

Perhaps the most outstanding feature of this volume, which was also manifest in the author's work on the Titanotheres, is the emphasis placed on the phylogenetic classification in which, instead of the classic Linnean system based solely on zoologic observation and the creational concept, a phylogenetic system is followed in which all divisions from the subspecies to the order are placed vertically, as succeeding each other during geologic time, rather than horizontally as observed in recent or existing time by Linnaeus and all zoologists. This results in an amazing number of divergent lines of ascent, there being no fewer than 43 newly discovered multiple lines for the Proboscidea as a whole.

There were four primary stocks of Proboscidea established by the initial choice of food in different habitats:

(1) An amphibious stock, adapted to rivers and swamps, of limited powers of migration. Represented only by the imperfectly known *Moeritherium* of northern Africa and possibly (Pilgrim) of southern Asia in Oligocene time. MOERITHERIOIDEA.

(2) A southern forest stock, adapted to forested lowlands. Represented by the *Deinotherium* of northern and central Africa and of southern Eurasia; known from abundant remains in Miocene to Middle Pliocene time. DEINOTHERIOIDEA.

(3) A northern stock, adapted to lowlands, to savannas, and to forests, with better developed limbs and powers of wide migration. Represented from the Lower Oligocene of northern Africa to the Miocene-Upper Pleistocene of Eurasia and North and South America. MASTODONTOIDEA.

(4) A Stegodont-elephant stock, adapted to plains, savannas and steppes; of browsing (forest) or grazing (plains) habits, also with powers of wide migration. Represented from the Lower Pliocene of southern Asia to the Pleistocene of North America and the Pleistocene and Recent of southern Asia and of Africa. ELEPHANTOIDEA. This last group constitutes the material for the second volume.

The position of the Moeritherioidea has been a matter of debate. Now, *Moeritherium* is excluded entirely from the ancestry of all later Proboscidea although a member of the order. It was an animal of amphibious habits comparable to the Hippopotami.

The Dinotherioidea are also an aberrant side line but had a decidedly elephantine body often of huge size and with a fully developed trunk, but no upper tusks. The sharply deflected lower jaw bore a pair of pointed decurved tusks, while the grinding teeth were very simple and unprogressive in structure. The use of these lower tusks gave rise to some remarkable and grotesque theories.

The greater portion of the volume treats of the Mastodontoidea. Originally, all that were known of this group were included under the classic genus *Mastodon* which because of subsequent discovery has been separated into 4 families, 15 sub-families, and 31 genera representing some 30 phyletic lines of ascent. The classification is by means of progressive divergent adaptations in the grinding teeth and tusks. The family classification is based on the fundamental pattern of the grinding teeth; the sub-family classification on the elongation or abbreviation of the mandible and the divergent adaptations of the inferior tusks.

The true mastodons to which alone the classic generic name is now applied include the *Mastodon americanus* so abundant in the forested area of the eastern United States. It was a short-jawed form with vestigial lower tusks.

The long-jawed mastodonts are in many ways the most interesting of all and include several phyletic lines. Some had an extremely long mandibular symphysis and lower tusks which might be greatly elongated and narrowed, but never broadened. These are called the prod-tuskers. The shovellers, on the other hand, usually had broadened lower tusks, sometimes excessively broad, with a worn, chisel-shaped edge giving evidence of their use, and with reduced upper tusks. Of these, under the Bunomastodontidae, are the shovel-tusked Amebelodonts, the tuskless spoonbills, Megabelodonts, and of the family Serridentidae the extreme Platybelodonts. These animals are supposed to have lived on the roots and stems of certain aquatic plants such as the water lilies, as do the moose and muskrat of today.

Under each generic phylum there is a full historical discussion with original descriptions and abundant illustration together with some presentation of Osborn's convictions, but with no real revision of species.

The restorations are particularly interesting, all of which were drawn by Miss Margret Flinsch, under the author's direction.

Altogether, this is a rarely impressive volume and represents a vast amount of research such as would be possible only to one in Professor Osborn's position. The final conclusions as set forth in the Appendix seem logical in the light of the carefully presented evidence, but whether other workers in this field will accept so extreme a phylogenetic classification as that herein presented remains to be seen.

RICHARD S. LULL.

FERNS OF NORTHEASTERN UNITED STATES

- - - - - - - - - - - by Farida A. Wiley

(Of the American Museum of Natural History)

(Published by the author. Price $1.00, plus fifteen cents postage)

IN this busy world, with all its strife and trouble, people are taking more and more to the out-of-doors for rest and recreation, to get away from the work and worry of their professions and occupations and to bring into life new experiences and new things to think about. Some take up outdoor games, while others go to nature for a study of trees, wild flowers, birds or the stars. Ferns form an interesting line of study. There are not so many species as to greatly confuse the learner, yet enough to occupy his attention for a long time. Some species are very common and are found on almost every walk in the woods, while others are scarce enough to lead one far afield. A few are so rare that to find one is the thrill of a lifetime.

The author, Farida A. Wiley, has been a student of ferns all her life. She has traveled hundreds of miles to observe certain species in their native habitats and to secure specimens for study and illustration. She is Director of Field Courses in Natural History given by the American Museum, and also Director of Nature Study Courses for Teachers given by the same institution. This fern book is not only dependable and reliable, but it is attractive.

Every fern is illustrated. The lower pinnae of all the larger species are shown, life size, on the left hand page. This is a new departure in fern books. The species can usually be determined by the shape and size of the lower pinnae. The entire frond is shown on the right hand page, reduced of course to scale (sometimes smaller than one would desire) showing the comparative size and shape of an average specimen.

The fronds of small species are shown life size. The illustrations of all but four rare species were made from specimens collected by the author. Sixty-four species, all told, are recognized. Line drawings show the shape and placement of the spore cases of each species and cross sections of the stems, which show pattern arrangement of the vascular bundles.

The author, in her description of each species, points out its chief characteristics, tells where and how it grows, how to distinguish it from other similar species with which it may be confused. The volume contains a key based on sterile fronds and a complete index of common ferns and scientific names.

This handy manual, popular, yet scientific, should be the companion of the fern lover on his tramps afield.

OLIVER P. MEDSGER.

THE COVER THIS MONTH

The prehistoric cave design from which the cover was taken became known to science in September, 1901. The background in silver is from a photograph of the actual rock in which the figures are carved; while the outlines in blue and red are a faithful reproduction of the design itself. The palaeolithic cavern in which it was found (Les Combarelles) is in the archaeologically famous Dordogne region in southwestern France. Exactly how many thousands of years ago the primitive artist incised this design in the stone cannot be said, but there is no doubt that it represents a very early period in the history of human art. A number of animals now extinct are depicted in the same cave. The people to whom the design is ascribed hunted the wild horse extensively, but there is no definite evidence that they domesticated it.

The horizontal lines crossing the flank of the larger horse have been taken by some to represent a serpent, but it is more likely that a thrust spear is intended. From the pointed end of it a deep groove ending in a hook extends downward, and this may represent blood flowing from the wound.

"Relief" in the Sub-Arctic

(Continued from page 291)

and pauperized recipient of Government rations with every interest in life destroyed.

Within a quarter of a century the caribou herds have been reduced from approximately thirty million to three million. The musk oxen have been almost exterminated. And for years the same thing has been happening to the Little Brothers of the Wilderness—the fur-bearing animals that are the economic life-blood of an area of a million and a quarter square miles. Soon the Far North is liable to be deprived of that animal life that makes existence possible and the natives to become burdens on the palefaces who deprived them of their land and the means to make a living. Surely our economic machinery must be out of gear when we can calmly contemplate these conditions, even in the very shadow of the pole, and see the results of selfishness and the fruits of thoughtless exploitation.

Science in the Field and in the Laboratory

Alberta—British Columbia Expedition—Anthropology News—Christmas Lectures—Newsom-Watson Expedition

The 1936 Alberta-British Columbia Expedition

Our knowledge of the mammal life in the vast territories of the Northwest is limited owing to the inaccessible nature of this country. While it will be some time before the Museum can expect to get a representative series of the mammalian life in Western Canada, it is extremely gratifying to be able to report the acquisition of 500 specimens from Southern Alberta and British Columbia.

The 1936 Alberta-British Columbia expedition returned in September after two months in the field. The members of the expedition were Mr. Colles Stowell and Mr. Wilbur Sawyer, who not only generously contributed financial aid but were of valuable assistance in the capture and preservation of the specimens, and T. Donald Carter, Assistant Curator, Department of Mammals, Museum representative and official collector.

Despite restrictions due to great forest fires, the expedition was able to carry through its plans to ultimate success. The main camps were established at Maycroft, Alberta, at an elevation of 4,700 feet, and at Tornado Pass, 7,000 feet elevation, this camp being on the great divide which forms a boundary between the provinces of Alberta and British Columbia. Later collecting was carried on near Twin Butte, Alberta, at an elevation of 4,000 feet, on the boundary of Waterton Lakes Park.

Among the interesting collection of small mammals, including water shrews, coneys, lemming mice and other species, was a series of Richardson's meadow mouse *(Microtis richardsoni)*, new to the Museum collection. This is a Northern race of the largest of the American meadow mice, one of the series measuring over ten inches from tip to tip.

Department of Fishes

At the annual meeting of the American Society of Ichthyologists and Herpetologists, held in Ann Arbor, August 31 to September 2, Dr. William K. Gregory was elected President for the coming year.

Dr. Rodolpho von Ihering, head of the Commissão Technica de Piscicultura of northeastern Brazil, has returned to Fortaleza. Dr. von Ihering attended the meetings of the American Society of Ichthyologists and Herpetologists at Ann Arbor, and the American Fisheries Society at Grand Rapids, after which he spent a month in New York using the facilities of the New York Aquarium, the Museum library, and the Department of Ichthyology in connection with his researches on the embryology of certain families of South American fishes.

Mr. G. M. Phelps, Jr., has presented the Department of Ichthyology with an interesting document in the form of the broken sword of a broadbill swordfish projecting some 18 inches diagonally through a three-quarter-inch plank from the bottom of a small boat. According to Mr. Phelps, who was in the boat off Montauk, the swordfish had been harpooned and brought to within about 15 feet, when it drove its sword through the boat's bottom and then broke it off in struggling to free itself.

Anthropology News

One of the most important and extensive projects of the Department of Anthropology in the past twenty-five years has been a comprehensive study of the life and culture of the Plains Indians living in the United States and Canada. As a part of this study, Doctor David Mandelbaum was engaged to carry on two field studies among the Cree Indians of Canada under the direction of Doctor Clark Wissler. During these field trips Doctor Mandelbaum accumulated important information on the former culture and history of the Cree as well as data which will make possible a classification of the numerous bands of this tribe. Doctor Mandelbaum is now at the Museum completing for publication a final report on this work. Under a fellowship from the National Research Council he expects to leave in December for India, where he will make ethnological studies among the Toda.

Jointly with the University of Alaska, the Department of Anthropology has undertaken an archaeological project in Alaska. Its main objective has been to determine the further occurrence of artifacts of a type similar to those found in Mongolia by the Museum's Mongolian expeditions and recently discovered in the vicinity of Fairbanks, Alaska. To this end, Doctor Froelich Rainey, of the Faculty of the University of Alaska, and well known for his archaeological work in Porto Rico, made a reconnaissance last summer along the lower Ranana and Upper Yukon rivers. He reports a successful exploration trip which has resulted in the location of many dwellings, sites and refuse heaps, the trial excavation of which is very promising.

As guests of the Department of Anthropology, two important conference groups met in the Museum. One was concerned with Anthropological exploration in South America; the other was called by the National Research Council, Washington, D. C. to develop a plan for the extension of psychiatric research to Indians and other representatives of the less literate peoples of the earth. The object in this case is to learn something about the personalities of individuals living under conditions we speak of as less civilized. It remains to be seen whether what we call personality is the result of the life one lives or comes about through some inborn characteristic. Among the members of this conference were Adolph Meyer, Johns Hopkins University; Edward Sapir, Yale University; Madison Bentley, Cornell University; H. S. Langfeld, Princeton University.

Chinese Amphibia

Dr. Alice Boring, Professor of Biology at Yenching University, is on sabbatical leave from that institution and has taken up residence in the Department of Herpetology. She is making a study of the amphibian of China utilizing the large collections brought back from the Central Asiatic Expeditions. Dr. Boring is well known for her numerous publications on the Amphibia of China. It is planned that the present study will be a complete account of the known forms.

An Apology

In connection with the article "The Eclipse in Kazakhstan" by Dr. Clyde Fisher in the October number of NATURAL HISTORY, the author wishes to call attention to an oversight. In discussing Prof. P. A. Manteufel's investigations of the behavior of animals during an eclipse of the sun, he regrets that he quite inadvertently forgot to mention the work of several well-known American naturalists. The results of the latter were published in the *Proceedings of the American Academy of Arts and Sciences,* Vol. 70, No. 2—March, 1935. The paper is entitled "Observations on the Behavior of Animals During the Total Solar Eclipse of August 31, 1932," and was written by William Morton Wheeler, Clinton V. MacCoy, Ludlow Griscom, Glover M. Allen, and Harold J. Coolidge, Jr. It is hoped that the oversight will be excused, the author states, as it was wholly unintentional and quite inexplicable.

Doctor Camp's Trip

Friends of the Museum may be interested to hear that Dr. C. L. Camp, formerly of the Departments of Comparative Anatomy and Ichthyology, has recently returned from a profitable trip to Europe and Africa. He succeeded in obtaining a number of interesting examples of mammal-like fossil reptiles from both continents, and made a study of museums in London, Berlin, Paris and elsewhere. He is now director of the Museum of Palaeontology of the University of California.

Fellowship for Doctor Murphy

Dr. Robert Cushman Murphy, of the Department of Ornithology of the American Museum, was elected to corresponding fellowship in the German Ornithological Society at its fifty-fourth congress, held at Bonn last July.

Peruvian Archaeological Collection

The Museum expedition to Peru (December, 1935 to August, 1936) conducted by Dr. Wendell C. Bennett, Assistant Curator of Anthropology, has furnished the Natural History Museum with a large collection representing several localities and civilizations on the north coast of Peru. The collections come principally from the valleys of Viru and Lambayeque.

The collection consists largely of pottery, both plain and decorated, but also contains specimens of copper, bronze, stone, bone, shell, wood, gourd, and fragments of textiles. Elaborate mortuary pottery and utilitarian cooking and drinking vessels which were found side by side in the same grave indicate that the prehistoric Peruvians not only placed articles of artistic merit and value with their dead, but also followed the more realistic custom of providing food and drink for the journey to the land of the dead.

One group of vessels and artifacts represent the Early Chimu or Muchic civilization, considered the oldest on the north Peruvian coast. This civilization is generally considered to have existed during the first five centuries after Christ. Although the earliest civilization yet discovered in this region, it is by no means primitive in any sense of the word. The clay vessels representing modeled portrait heads, the figure and animal modeling, and the faithful reproduction in clay of everything from houses to food plants are the finest examples of clay modeling to be found in the Peruvian civilizations. Furthermore painted scenes on vessels are not only admirable as artistic achievements, but are valuable in portraying excellent pictures of the life and customs of the times.

A second group of vessels and artifacts represents a civilization or period which follows the Early Chimu. Many characteristics of the previous civilization still persist, but mixed with them is a definite influence from the region of Recuay in the highlands of Peru. This combination of Highland and Coast civilizations to form a new type, neither one nor the other but influenced by both, is of archaeological importance because the geographic features of Peru intensify regional differences, especially between the coast and the mountains, and make inter-regional chronologies difficult to establish.

Other vessels represent an influence from the south typified by designs painted in black, white, and red colors. Finally a large percentage of the collection is of black pottery so characteristic of the Late Chimu period which preceded the Inca civilization on the coast of Peru. Graves of the last two periods (the Red-White-Black and the Late Chimu) were found in an abandoned habitation site of the Early Chimu period, thus furnishing further proof that the Early Chimu is truly Early.

The collection from Lambayeque valley is the only documented material known from the Far North Coast region of Peru. Consequently it will be of importance in classifying other collections from that region which have been made by untrained treasure-seekers who pay little attention to records of their work.

This collection is now being catalogued prior to more thorough study and more detailed conclusions.

Doctor Pinkley's Brain Research

Dr. George Pinkley, of the Department of Comparative Anatomy, and Mrs. Pinkley have returned to New York after four years abroad. They remained in London for more than two years, where Dr. Pinkley made research studies in comparative anatomy, vertebrate palaeontology, and anthropology with especial reference to the evolution and phylogenetic history of the human brain. These studies, which were partly in the interest of the James Arthur Foundation for the Study of the Evolution of the Human Brain, were made in the laboratories of Professor Sir Grafton Elliot Smith and Professor D. M. S. Watson of the University of London, and at the British Museum (Natural History). After leaving London, Dr. and Mrs. Pinkley were in Egypt for a short time, visiting the fossil deposits of the Fâyum desert basin, where remains of the oldest known anthropoids have been found.

In China, Dr. Pinkley, assisted by Mrs. Pinkley, continued his studies on the brain at the University of Hong Kong and at the Peking Union Medical College. They were also guests of the National Geological Survey of China at the Cenozoic Research Laboratory and at the excavations at Choukoutien, where specimens representing at least twenty-four individuals of the famous fossil Peking Man have been found. On a trip to Borneo and the Philippine Islands, the Chinese Geological Survey cooperated in sending Mr. Bien Mei-nien of the staff of the Cenozoic Laboratory with Dr. and Mrs. Pinkley. Here they collected specimens of smaller primate and insectivorous mammals, especially for Dr. Pinkley's researches on the brain; and in addition, made a reconnaissance exploration of cave deposits which might yield further evidence of fossil man in the Far East.—W. K. G.

Jonker Diamond

We have been informed that, contrary to the impression given in the October issue of NATURAL HISTORY, the Jonker Diamond was displayed not only at the American Museum but also at the store of the Grogan Company in Pittsburgh.

Junior Astronomy News—Christmas Lectures

The annual Christmas science program of The American Institute Student Science Clubs will be held as usual at the American Museum on December 28 and 29. Participation in this program is open to all of the Institute's member science clubs in New York City and suburbs.

The Christmas Lectures will be held at noon on each of these days, with two world famous scientists or explorers speaking on each program. This year Dr. Harlow Shapley of the Harvard College Observatory will speak. And either Dr. Hugo Eckener or Captain Lehman of the new German dirigible "Hindenburg" will also appear. The other two speakers will be announced at a later date. These lectures will be broadcast over a national hook-up so that all science clubs and all young people interested in science over the country may have the opportunity of hearing them.

The Christmas Lectures are modeled somewhat on the Christmas series held by the Royal Institution of London for over a century. The British series have been conducted by such brilliant scientists as Faraday, Tyndall, Bragg and others. It is the plan of The American Institute to provide an opportunity for the young people of America also to hear the world's great scientists. In the past two years such men have appeared on the Institute program as: Dr. Harold C. Urey, Nobel Prize Winner in Chemistry; Dr. W. F. G. Swann, Director of the Bartol Research Foundation of Swarthmore; Captain A. W. Stevens, Commander of the 1934 Stratosphere Flight—the highest ever made, and others.

The Science Congress for clubs will also be held on these two days. The Congress plan is based on meetings of the American Association for the Advancement of Science, with section meetings on a variety of science subjects held simultaneously. At these meetings members of the clubs read papers or give demonstration talks of their researches in the clubs during the school year. A junior club member acts as the chairman of each meeting and leads the discussion which is invited after each paper is read. Prominent scientists are asked to attend the meetings as an honor to the speakers, but they take no part in the program which is conducted entirely by the boys and girls themselves.

In the past papers of great merit have been presented. And meetings on many specialized subjects have been arranged, including such general topics as: Genetics, Microscopy, Cinephotomicrography, Photomicrography, Electrified Gases, Light Waves, Vacuum Tubes, Aerodynamics, Airplane Construction, Chemistry of Visible Particles, Applied Chemistry, Combustion, Biology, Biological Preparations, etc.

Newsom-Watson Anticosti Expedition

The Newsom-Watson Anticosti Island Expedition of the American Museum of Natural History has just returned to New York after studying various forms of animal life on Anticosti Island, which, from a natural history standpoint, has been more or less a question mark until the present time.

Anticosti Island is 135 miles long and 40 miles wide, and lies in the entrance to the Gulf of St. Lawrence, Province of Quebec, Canada. This 3000 square miles is one and a half times as large as Prince Edward Island, yet no detailed complete topographical survey has ever been made of the island, except along the coast and by timber cruisers inland.

In a preliminary report submitted to Dr. Roy Chapman Andrews, Director of the American Museum, Mr. William M. Newsom, leader of the Expedition who was accompanied by Mr. Earl S. Watson, said:

"The Newsom-Watson Anticosti Island Expedition of the American Museum of Natural History arrived at Anticosti Island on September 15th, after being held up for three days at Riviere aux Renards in the Gaspé Peninsual on account of gales.

"At Port Menier three deer were taken; the skulls and skins prepared for the Museum. Also, one complete deer skeleton was taken and is being shipped to the Museum.

"At Port Menier a good deal of time was spent taking the speed of the deer with a stop watch. This work was done on the open fields near Baie St. Claire. When a deer was found in a favorable position, a shot was fired under it. The bullet tossed gravel on the deer and marked the spot where the deer started. As the deer reached the edge of the field, or passed a mark such as a stone or tree that could be identified later, his time was taken and the distance measured with a tape. Figures will be available later, but we can say now, the deer is not going nearly as fast as he appears to be and many a hunter will find his alibis for missing a deer are not as sound as they were heretofore. This is the first time the whitetail deer has been clocked with a stop watch.

"Experiments were also made at Port Menier with camouflaged clothing as compared to ordinary hunting dress, to ascertain how well the deer can see the hunter and what effect the hunter's dress has on his success. It was not difficult to find deer on which to experiment, as we counted as high as 72 deer in one day.

"On leaving Port Menier, we went along the North shore of the island in a 32-foot boat making various stops along the way. There are many seal along the shore and four of these of various sizes up to 7 feet long were taken and the skins and skulls sent to the Museum.

"At Vaureal River, about 100 miles run from Port Menier, we secured a fine black bear, the skin and skull of which is being shipped to the Museum along with several other skulls collected at points where bear has been shot in the past. It is, of course, too early to say whether or not this is a new sub-species of black bear. But we find the often published story that the island has a new variety of very large brown bear is a myth.

"Up Vaureal River, we went inland to the falls—170 feet high—and made camp there, making excursions to the plains above the falls.

"Regarding small mammals, there are fox—red, cross, and silver—beaver and other mammals—all protected by the Company that owns the island, and we were requested not to take these as the Company is trying to build up revenue from the proceeds of trapping these. There used to be quantities of marten, but it is said that none are left, although there are rumors of a marten's tracks having been observed in the past year.

"There are no mink, weasel or fisher and neither chipmunk, squirrel, skunks or porcupine have ever been found in the island. There are hares, but we saw none. We collected whitefooted mice. At Port Menier there are house mice and the common Norway rat, no doubt brought in by the boats. There are frogs, but no snakes on the island.

"As far as we could learn, there are no shrews. We took none in the traps and several trappers working for the Company who are familiar with them in other countries, told us there are no shrews in Anticosti. We showed colored pictures of the shrew to several local trappers who were born and have always lived on the island, and they told us they had never seen one. This seemed so amazing to us, we made careful inquiry everywhere we went, but the results were the same in every case—no shrews. There may, of course, be some inland where we did not go.

"We found some ruffed grouse, but they are not very plentiful. We were told that during the hard winter of 1934 ptarmigan came to the island, but left in the spring and have not been seen since that time. Moose are not plentiful—a few only having been seen by the trappers this year. We saw only one track. There are three elk (cows) on the island and they are very tame. The Company was forced to shoot the only bull elk as he became a menace. The Canadian government and the Company have released a herd of reindeer, but they are not increasing rapidly."

Education Notes

The Scholastic Exhibit of drawings, designs, pottery, jewelry will open in Education Hall on November 12th and continue to December 15th. This exhibit has been arranged by Mr. Forest Grant, Director of Art for the Board of Education.

* * *

Mr. John R. Saunders and Mr. Robert R. Coles are continuing their educational radio programs on "Today's Natural History." The talks are given over WNYC on Wednesdays at 4 p. m. and over WHN on Fridays at 12 noon, and will include current news items in the world of natural science. Follow-up tours of Museum halls mentioned in the broadcasts will be made on Saturday afternoons following the talks, at 3 o'clock.

LOOKING INTO MEXICO

If the article in this issue of NATURAL HISTORY on the evolution of Mexican art by Dr. George C. Vaillant and the series of photographs of the new motor highway to Mexico City by Charles H. Coles tip the balance for some readers in favor of a trip to that country, it may be interesting to note some of the many historic and scenic attractions that await the visitor there.

Although it is impossible to enumerate in the space of this article the many places of interest in Mexico, the following trips, suggested by Doctor Vaillant, Associate Curator of Mexican Archaeology, may help you to decide what to see first. For the greatest enjoyment it is recommended that the first day or two after arrival in Mexico City be quietly spent becoming acclimated, as the city lies at an altitude of over 7000 feet.

• TRIPS THAT CAN BE MADE IN A DAY FROM MEXICO CITY

1—Using Mexico City as a base and requiring only one day, an interesting trip may be made to the buried city of San Juan Teotihuacan with its remarkable pyramids and partially excavated evidence of a highly developed civilization that flourished a thousand years before the arrival of Columbus in America. The pleasantest way to see San Juan Teotihuacan is to leave Mexico City about eight in the morning and drive directly to the pyramids, arriving at about nine o'clock, before the sun is too hot. On the return trip you may stop at Acolman and the Villa de Guadalupe, have a picnic lunch at El Bosque del Contadero, the site of the former palace of Nezahualcoyotl; thence home by way of Texcoco and Chapingo (affording an opportunity to see the painting by Rivera that is considered his finest work) and the famous walls of Huexotla.

2—One day's sightseeing should include a visit to the National Museum, the Ministry of Fine Arts, the National Theater which contains a copy of the controversial painting by Rivera that once decorated Rockefeller Center in New York, and the Convent of Churubusco, followed by lunch at the San Angel Inn. After lunch you may visit the Convent of San Angel and Copilco, which is the nearest point to the volcano that once buried this part of the countryside in molten lava and where may be seen the skeletons of human beings interred long before. Here one may also see, caught in the lava flow hundreds of years ago, the pyramid of Cuicuilco.

3—A long morning's trip is the visit to the famous Tacuba Noche Triste Tree, under which Cortez is supposed to have wept over his defeat; the Convent of Tepoztlan, renowned for its very rich churrigueresco, and return by way of Tenayuca, Aztec pyramid, of which there is a very fine model in the American Museum of Natural History.

4—It requires only one day, with a leisurely start, to visit the market at Toluca and the ruins of Calixtlahuaca and on the way back, turn off to see the Convent of El Desierto de Los Leones, and return via San Angel.

• TRIPS REQUIRING TWO OR MORE DAYS

1—A very interesting trip, requiring from three to four days, is to take the train to Morelia, capital of Michoacan. From Morelia you can go to Lake Patzcuaro, surrounding which are the primitive villages of the Tarascan Indians. You can boat on the lake and visit the Island of Janitzio and the ruins of Tzintzuntzan, once the capital of the great Tarascan empire. This trip could include a visit to the famous gardens of Uruapan, two and a half hours away by train.

2—At least four days should be devoted to the trip to Pueblo and Oaxaca. Puebla may be reached in two and a half to three hours from Mexico City. The beautiful altar in the Convent of Huexotzingo should be visited en route, also the famous pyramid of Cholula may be seen on the way to Puebla. Puebla is interesting for its many churches, its cathedral and its potteries; Cholula, for its pyramid and the Church of San Francisco Acatepec—renowned for its beautiful tiles.

From Puebla one may take the train to Oaxaca. As this requires a very early morning start, some people prefer motoring to Tehuacan for the night and boarding the train for Oaxaca next morning at a reasonable hour. Oaxaca, which is an interesting old southern city and Indian market, is the starting point for trips to the ruins of Mitla. These are prehistoric and of wonderful design, with monoliths, intricate mosaics, mural decorations and many hieroglyphics. They were old when the Spaniards first saw them 400 years ago. From Oaxaca a visit may be made to Monte Alban and the Church of Santo Domingo. Return by Pullman to Mexico City.

3—Two or three days should be allowed for the trip to Cuernavaca. If you go by motor you can leave in the morning, taking the long route via Cuauhtla and en route, see Chalco Lake, with its Aztec communities and lake life; the famous open chapel of Tlalmanalco Convent; Ameca-meca with its views of volcanos, and Yautepec, the home of Zapata. Cuernavaca, by the short road, is only forty-four miles from the capital and the scenery, whether one goes by car or train, is some of the finest in Mexico.

The points of particular interest in Cuernavaca are the palace which was built by Cortez in 1530, and the Cathedral. From Cuernavaca you may make a day's excursion to the Cacahuamilpa Caverns and, on the way, stop at the Xochicalco ruins, so old that all knowledge of its builders had been lost before the advent of Cortez. The return to Mexico City may be made by the short route mentioned above.

4—Yucatan. As there is no railroad to Yucatan, the trip must be made by plane to Merida. There is a regular plane schedule by a subsidiary of the Pan-American Airways. With Merida as a base, you can motor to the ruins of Chichen Itza, Uxmal and Kabah Labna and Sayil. (If you travel in Yucatan it is advisable to carry a small bottle of gasoline which, when daubed with cotton, is an effective means of extracting the ticks which infest that part of the country.)

• TRANSPORTATION BY RAIL

Travel from any point in the United States to Mexico City is convenient and luxurious. By the Southern Pacific or Missouri Pacific Railroads you can reach one of the main gateways to Mexico and on the same Pullman, be carried across the border and, via the National Railways of Mexico, to Mexico City. Through sleeping car service is operated daily from St. Louis, Missouri, and San Antonio, Texas. The train leaving St. Louis at 6.30 P.M. arrives at San Antonio the following evening. By breakfast the next morning you have crossed the Rio Grande at Laredo and are speeding through Northern Mexico, arriving at the capital the following evening. Customs inspection at the border is made on the trains.

The National Railways of Mexico now provide high-class Pullman sleeping car service with standard Pullmans north of Mexico City and Pullman-built sleepers, designed for the narrow-guage railroad lines, south of the capital. Meal service includes fully equipped cafe and broiler buffet cars under the management of the Pullman Company. The ticket agents at principal points and most of the conductors speak English. The trip via any one of the several different routes from the border to Mexico City is varied and interesting.

• RAIL-PLANE

For those whose time is limited there is a daily airplane service maintained by the Mexican Aviation Company—a branch of Pan-American Airways, Inc.—between the border and Mexico City. A twelve-passenger plane, with a crew of two pilots, radio operator and courier, leaves Brownsville, Texas each morning at 8:30, arriving at the capital at 1:30 P.M.

• BY WATER

The Grace Line, the New York and Cuba Mail Steamship Company, and several smaller lines operate ships between the United States and Mexico. For those who have the time, the trip to Mexico by sea is the pleasantest.

The New York and Cuba Mail Steamship Company operates the most direct line from New York to Mexico stopping at Havana, Cuba, and Progresso on the way to Vera Cruz. It is also the only way to get to Yucatan without flying, except via New Orleans. The Grace Line's luxurious new ships sail on a bi-monthly schedule between New York City and the port of Mazatlan on the west coast of Mexico. Also, from San Francisco and Los Angeles, California, to Mazatlan. The ships sailing from New York stop at two ports in South America, Panama, through the Canal to Costa Rica, El Salvador and Guatemala. This trip takes thirteen days from New York City to Mazatlan. From San Francisco to Mazatlan takes four days, with a stop at Los Angeles on the second day. The Grace Line also make a round trip arrangement whereby one may go one way by rail and the other by boat. They will carry your automobile at a not exhorbitant rate.

However, all types of automobiles can be hired in Mexico. Fords with drivers can be rented for approximately twenty-five cents in American money for each city trip in Mexico City. Larger cars cost from approximately seventy-five cents to a dollar and a half (American) per hour. In other cities and towns the transportation arrangements are similar to those in the capital, though less extensive and often a little cheaper.

Since schedules and facilities are liable to fluctuate, the prospective tourist is advised to consult an accredited travel agent for detailed information.

• CLIMATE

Although Mexico has a variety of climates, depending mainly upon the differing altitudes, the greater part of the country has a summer temperature of approximately 71°F for the warmest month, and perfect autumn weather all winter. There is a narrow strip of low country along both coasts that is very hot; then a quick rise in terraces to the great plateau 1500 miles in length by 530 in breadth, with a mean elevation of about 5000 feet above sea level—Mexico City is 7349 feet. Above this, rise the snow-capped Sierra Madre Mountains.

There is never any snow in any of the cities or towns of Mexico that the average tourist visits. The mercury rarely approaches the freezing point even in Mexico City. The mid-year months are cool and delightful all over Mexico except along the sea shore. The rainy season on the Mexican plateau is between June and September but the showers usually occur in the P.M. with clear days. April and May are the dusty season and not as pleasant as other months.

• CLOTHES

If you intend to visit Vera Cruz, Tampico, Manzanillo, or other coast towns, you will find very light clothing, suitable for the tropics, necessary for your stay in those parts. For the rest of the time, ordinary fall clothing, with a light coat for the cool evenings, will be most comfortable. The hotel dining rooms and restaurants in Mexican cities do not require evening dress, which is reserved for private social occasions.

• WHAT TO BUY

The Mexican Government will not allow Mexican relics of historical value to be taken out of the country, except by official permit obtainable at the Department of Historical Monuments, and they are watched for during the inspection of baggage at the custom-house. However, there are many interesting pieces, old and genuine but not of historical value from the government's viewpoint, which can be taken out without difficulty.

The most popular purchases are: drawn work from Mexico City, Queretaro, Aguascalientes and Celaya and pottery from Mexico City, Guadalajara, Puebla, Cuernavaca and Oaxaca. Each of these cities has considerable fame for its own particular product, the Guadalajara ware being perhaps the finest. Stones may be purchased in the following places: Queretaro for opals, Puebla for onyx and Mexico City for jade beads, masks and ornaments taken from the old Indian tombs of Mexico. In Mexico City also are marketed the turquoises mined near Zacatecas. Sarapes—the Indian blanket of Mexico—sombreros, palm hats and lace mantillas are other popular purchases. Some of the latter are made in Mexico but the finest are imported from Spain. Decorative articles to be collected in Mexico include lacquer work, silverware and paintings by modern Mexican artists. Useful souvenirs are baskets, sandals of leather (if well cured) and straw hats; in Yucatan, hammocks.

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SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

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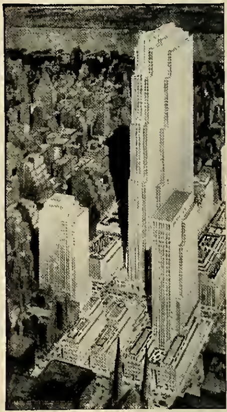
BULLETIN

Vol. LXXII, Art. IV.—The Hyraxes Collected by The American Museum Congo Expedition. By Robert T. Hatt.



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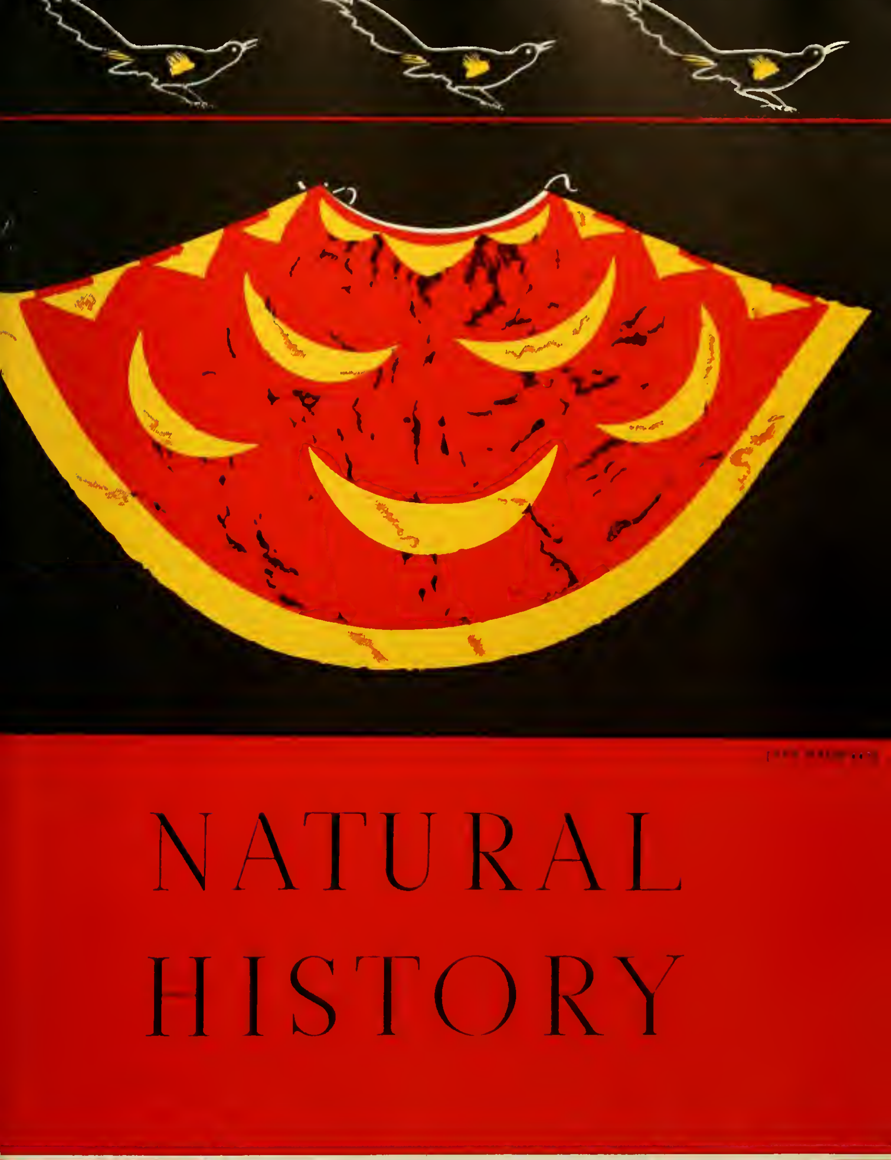

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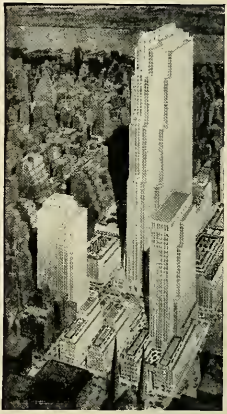

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PUBLICATION OFFICE: American Museum of Natural History, Seventy-ninth Street at Central Park West, New York, N. Y.

EDITORIAL: Edward M. Weyer, Jr., Ph.D., Editor; D. R. Barton, Frederick L. Hahn.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Supervisor, Charles J. O'Connor.

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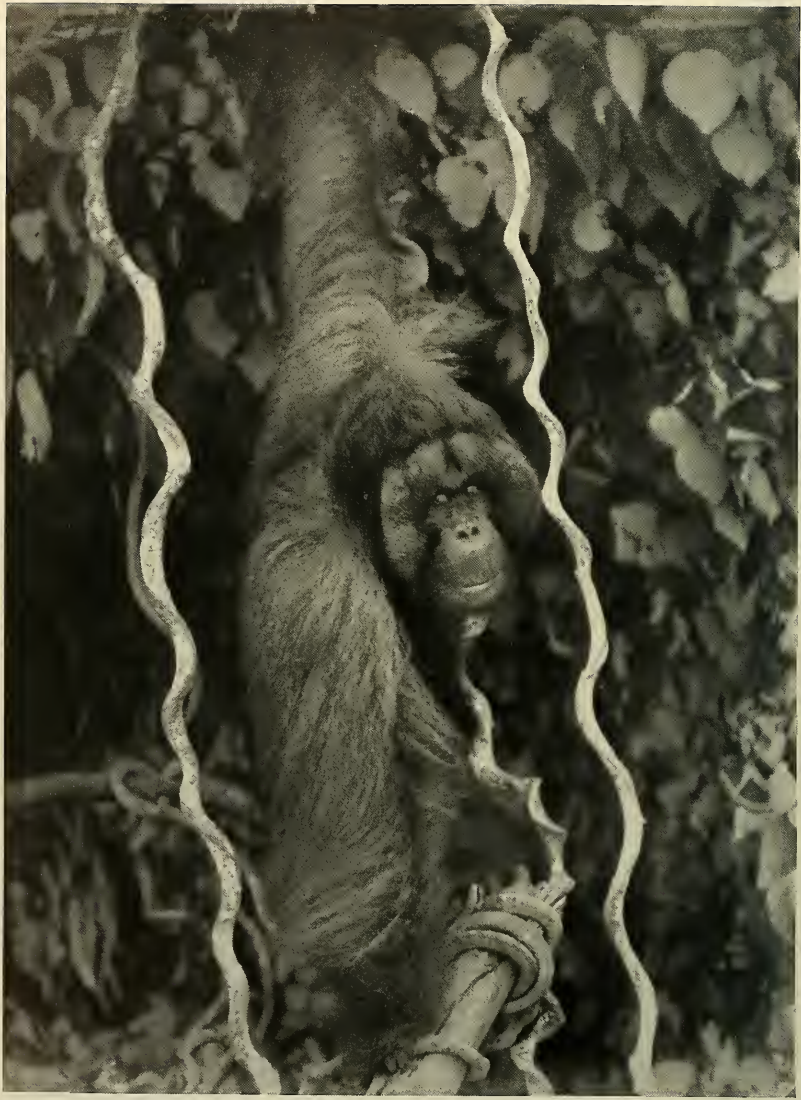


Orang-utan of Borneo

Weighing an estimated 300 pounds, the spectacular creature recently brought back by Martin Johnson, is perhaps the largest orang-utan ever captured. Being a mature adult, he will never abandon his jungle habits, and will thus make a valuable subject for scientific study

The Master Key to Oil

How the petroleum geologist locates buried reservoirs of "liquid gold," using microscopic fossils as clues

By BROOKS F. ELLIS
New York University

FAR below the earth's surface a huge steel drill dangles at the end of a half mile of cable. Endlessly it plunges up and down, punching a hole ever deeper into the earth in quest of hidden reservoirs of petroleum.

A 3000-foot well often costs as much as $30,000. Will that $30,000 pay for a dry hole in the ground or for a new fortune? What assurance is there that oil reservoirs exist in any particular locality? Can this be determined from the surface?

"Oil smellers"

Since the days of Drake and his Titusville well, many answers have been given to these questions by a great variety of people. An endless procession of "oil smellers," divining rod experts, peach twig manipulators and assorted quacks have offered their services to oil prospectors at a price. In one celebrated instance, a peach twig expert grasped the forked stick of his cult and after an appropriate wait solemnly pronounced, "There is no oil here." Unknowingly he stood directly over a bruised pipe line transporting oil in a six-inch stream. Again a "smeller" walked across a field, drove a stake and on that spot a hundred-barrel well was brought in. In the next valley he subsequently located a dozen dry holes.

Endlessly these instances were multiplied, with the law of averages getting in its deadly work, until most producers were driven to the verge of apoplexy by the mere suggestion that anyone could help them locate oil well sites. Small wonder then that they turned a deaf and stony ear to the geologist's suggestion that he might be able to reduce the hazard. Nor was their attitude particularly softened by the fact that the early attempts of geologists weren't anything to brag about. Gradually, however, they were forced to admit that the application of scientific principles and geologic knowledge did materially reduce the number of failures. The large companies were the first to recognize this and to establish geologic departments to guide them in the search for petroleum. Smaller companies and individual operators followed their lead more slowly; and by the second decade of the present century the value of the geologist to the industry was well established.

The petroleum geologist did not rest content, however, but continued diligently to improve his methods and to search for a master key to his problems. What he wanted was some means by which he could get a picture of subsurface conditions, much as the X-ray guides the operating surgeon.

In sedimentary rocks

The oil-bearing rock layers are nearly always of the sort that have been laid down as sediment in bodies of water. Subsequent to their formation, these rock layers have been buried beneath other accumulated beds; and continental uplift has in many instances raised them far above the surface of the sea, so that rock layers containing petroleum are often found hundreds of miles from the present oceans. These reservoir rocks are chiefly sandstones or porous limestones, although considerable oil has been produced from conglomerates and shales. In the sandstones, the oil occupies the space between the grains of the rock not filled in by the cementing material. This space would appear, on first thought, to be too small to accommodate much liquid; tests have demonstrated, however, that up to 40 per cent of the total bulk is porous in some sandstones, although the average is about 16 or 17 per cent.

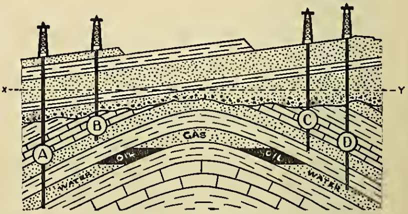
Sedimentary rocks cover three quarters of the land area of the earth and extend far underground in complicated series. Most of them do not contain any oil, but some hold oil worth millions of dollars. The petroleum geologist's problem is to determine whether beds that have elsewhere proved to be petroliferous lie below, and if such is the case, where they can be tapped to best advantage by drilling.

In determining what beds underlie a particular area the geologist makes extensive use of the Geologic Column. This is a sort of master chart, containing all of the formations or layers of the earth's crust with the oldest at the bottom and the youngest at the top. By studying the rocks exposed in mountain sides, canyons, mine shafts, tunnels and drill holes, geologists have been able to determine the succession of beds in the various areas examined. These local succession charts were then combined to form the master chart.

Dating the rock layers

Fossils have been one of the most important tools used in correlating beds from various areas and placing them in their proper order in the Geologic Column. They are the remains of plants or animals that lived in the prehistoric seas when rock-forming sediments were being deposited, and sank to the bottom along with inorganic sediment and so were buried and preserved. Certain of them serve the geologist as labels in establishing the age of the rock layers. By using these index fossils the petroleum geologist is able to identify the surface rocks in his area and to ascertain how they fit into the Geologic Column. Through inspection of the column he is then able to say whether beds that have elsewhere proved to be petroliferous may lie below.

But the location of productive well sites depends not only on the existence of petroliferous rocks but also upon structural traps in them capable of causing the accumulation of oil in one place. A glance at the accompanying diagram will show one of the commonest and most important types of oil trap. It is a wave-like arch in a series of layers produced in times long past by continued pressure. Natural gas and oil accumulate in this type of trap because both of these substances are lighter than water, which is the commonest occupant of sedimentary rocks. All too often for the producer's peace of mind the driller encounters salt water; whereas the oil, which rises above the water and the gas that rises still higher is usually found where it has been caught in a structural trap. Another important type of structural trap is the dome. This is really a modification of the arch or anticline; in it, as the name implies, the layers have been bulged upward to form a dome. Here the accumulation of oil and gas occurs in exactly the same manner as in the elongated anticline. Likewise in other structural traps involving tilted layers, separation under gravity follows the same principles.



How "Forams" Locate Oil

The search for buried reservoirs of oil is a search for traps in the rock layers. Identical microscopic fossils from drill samples at points A, B, C, and D reveal the presence of a dome-shaped structure contributing to the accumulation of oil and gas as shown

Larger fossils useless

Since these structural traps in reservoir rocks are subsurface features, usually not apparent at the surface, how is the geologist to detect their presence? How is he to identify beds that lie far below the surface and to determine their slope? The larger invertebrate fossils, which served in the construction of the Geologic Column and are used in ordinary correlation, are of very little service. Because of their large size they are broken up by the drill so as to be unrecognizable and of little use in correlation. What then is the precious clue that will unlock the door of the earth's treasured fluid?

The science of physics has been of some service. Instruments have been devised which interpret underground structure to some degree through the behavior of artificially produced earthquake waves or by measuring variations in the pull of gravity. But the value of these findings has been found chiefly in special cases and as checks on other methods.

Though it seemed for a while that fossils had been of little account beyond the precincts of geologic science, the real key to the riddle of petroleum geology was found to lie in a certain kind of very small fossils. In well records and test borings where the usual index fossils are practically useless owing to their being broken up, a group of organisms has come to the rescue of the petroleum geologist as though it were practically made to order. These are the Foraminifera, or "Forams" as they are colloquially referred to, a group of single-celled animals with hard shell-like internal skeletons. They have a wide geographic distribution, and many of them possess the fortunate attribute of having a very narrow range geologically. Combined with these features is the all-important one of minute size, which allows them to escape destruction by the drill. They are the master key to petroleum.

Guide to oil "traps"

Not only do they serve to identify the various layers of rock encountered by the drill, but having done this they enable the geologist to plot the domes, ridges and valleys of buried structures. This he does by comparing the depths at which a key horizon is encountered in the various borings in the area being studied, just as a surveyor plots mountains and valleys from the altitude of selected points. Thus the Foraminifera are the clues to the location of the all-important structural traps.

Certain members of this group have been known for a very long time. In 450 B. C. Herodotus saw the fossilized tests of forms that are now known as Nummulites or "Money Stones." This form is one of the giants of the group since it averages almost an inch in diameter. Owing to the large size of the tests Herodotus was able to observe the structure and form quite well and from his observations to conclude that they were once parts of living organisms.

The builders of the Pyramids must have seen Nummulites also and wondered what they were, for the blocks used in their construction are composed quite largely of the shells of these animals.

Aside from the giants of the group such as the Nummulites, most Foraminifera are very minute. The average specimen measures less than a fiftieth of an inch in diameter, and for this reason their existence was not suspected until the microscopes of pioneer workers revealed vast hordes of marvelously beautiful specimens. Soon naturalists in many lands became intrigued with the group and hundreds of papers were added to the literature. Interest seems to have reached a peak in 1884 with the appearance of H. B. Brady's monograph describing the Foraminifera dredged up on the scientific voyage of *H.M.S. Challenger*. Since then, other expeditions, in addition to individual efforts and study, have resulted in the accumulation of a vast amount of information on the group. As a result, the limits of the order have been quite accurately established, and more than 12,000 species, grouped under some 1100 genera, have been described and figured.

The basis of this classification is the test or shell-like internal skeleton, the presence of which is diagnostic of the group. It may consist of one chamber or of many chambers arranged according to a fixed pattern which is consistent for any genus but varies greatly between genera. The material of this test may be chitin (a horny substance), silica, agglutinated sand-grains or calcium carbonate. In the latter case it may be clear and glassy or it may resemble unglazed porcelain.

Living "Forams"

Present-day members of this group are almost entirely marine and range from deep to shallow water. Many forms are pelagic and occupy the surface waters of the open sea. Millions of square miles of ocean bottom are covered with the abandoned shells of these animals that have rained down on the slopes of the oceanic abyss where it does not exceed 16,000 feet in depth. This depth has been termed the "Foraminiferal snow line," because no shells accumulate below it, owing to the strong solvent action of very deep oceanic waters.

Such, then, is the group to which the petroleum geologist turned in his search for subsurface indicators. Swiftly and effectively he turned the new tool from purely academic tasks to intensely practical ones. All of the wisdom of the old masters was drawn upon and their methods were quickly re-vamped to meet the new needs. To these the practical paleontologist added much in new points of view, methods and technique.

His contributions were especially extensive in methods of handling these tiny fossils. Many ingenious devices and processes were developed to meet practically any condition and state of materials encountered. Some of these are, of necessity, quite complex, but the end result is the same—namely the mounting of specimens for observation under the microscope.

One of the simplest ways of accomplishing this task is first to boil the samples in water to loosen the specimens from the matrix. When this is ineffectual or too slow, ammonium acetate is sometimes added to the water and the boiling is carried to a point where the solution is super-saturated. On cooling, the ammonium acetate, which has penetrated the matrix, crystallizes, and the attending expansion serves to aid in pulverizing the material surrounding the specimens. The sample is then washed in running water and dried, after which it is placed in a sorting dish about three inches in diameter. Next it is examined under the low power of a binocular microscope. Since the field covers only a small portion of the dish, a special mechanical stage is used to insure a complete examination of all portions of the tray. Specimens are singled out and picked up on the moistened tip of a very fine sabel's hair brush, and finally mounted with water-soluble glue on opaque slides. They are then ready for study and final identification.

Through the microscope

This detailed examination is best accomplished when the slide is mounted on a universal stage which permits the specimen to be observed from all sides except that applied to the slide. If a universal stage is not used it then becomes necessary to loosen and re-cement it on the slide in the several positions necessary to permit complete observation. Since the average size is well below a fiftieth of an inch, the latter method often results in the loss or destruction of specimens.

The larger Foraminifera are exceedingly complex and it is necessary to prepare thin sections of these. This is accomplished by grinding away the specimen on one side until the plane of grinding passes through the structure to be studied, cementing it on a transparent glass slide with Canada balsam, and then grinding away the other side until the desired thinness is secured. The section is then studied under the microscope by means of transmitted light. Many of the larger forms cannot be identified except through study of the internal structure of their tests or skeletons.

Need of "dictionary"

As soon as this new use for Foraminifera was discovered, geologists doing petroleum work found their efficiency greatly increased, especially when dealing with buried structures. Before long, however, it became evident that only a small fraction of the potentialities of these fossils could be realized. This was due to the fact that really effective work with the group depends on access to the literature in which individual genera and species have been described. Here the geologist found a most discouraging situation. Although scientists have been working on this group more than 150 years, their efforts have been individual and more or less independent. Consequently, the descriptions of the genera and species, so necessary to petroleum work, were about as much use as a dictionary would be if the definition of words were written in fifteen different languages, and the various parts of the book jumbled and scattered.

This, indeed, was a major obstacle. Here was one of the finest keys to the problem and yet it could not be used except to a very limited extent. It was like a hundred horse power automobile with a capillary tube for a gas line.

Long before anyone had thought of using Foraminifera for such practical things as petroleum prospecting, the chaotic conditions of the literature had been a source of great difficulty to all workers. By the end of the nineteenth century, the situation had become so had that serious attempts were made to remedy it. One of these, Sherborn's great Index to Foraminifera, came out in 1893-96. This work was a distinct advance in that it listed the genera and species that had been described, and indicated where they could be found in the literature. Although this served as an important guide, it still did not overcome the difficulty of securing the literature, nor did it pretend to untangle the hopeless snarl.

Once Foraminifera became important in petroleum prospecting, however, the need for effective action became very pressing. As a result, two great American students of the group set to work on critical studies of the genera, and both published the results of their investigations. Both of these works covered the same field, but from somewhat different viewpoints, and both became important guides to paleontologists. In spite of the excellence of these publications, the fundamental problem of access to the literature was not solved, nor did either scientist attempt the Herculean task of systematizing the more than 12,000 species.

Many languages

About this same time, the author became interested in the situation and envisaged a publication in which the essential parts of the literature would be assembled. Older and more experienced students of the group promptly pointed out the hopelessness of such an undertaking. They emphasized the fact that one person working all of his time could scarcely keep up with the current literature, to say nothing of systematizing the vast bulk of old European writings. Then there was the matter of language difficulties, since the scientific literature of some twelve to fifteen different countries was involved. These were the major barriers, but in addition there were literally hundreds of minor ones that served to make the task even more forbidding and apparently impossible.

Nevertheless, the desirability of such a compilation loomed so large that it was started by the author some eight years ago as a purely private venture. Soon, however, New York University and the American Museum of Natural History became interested in this attempt and lent their aid to its furtherance. The Museum offered its very extensive library as a source of materials, and the University provided space and equipment. Student assistants, many of them volunteers, gave their time and talents in establishing the foundations of what has later proved to be an enormous enterprise. Of a necessity, the work went forward slowly as none of the individuals engaged in it were able to spend all of their time on this endeavor.

In 1933, however, a few trained people became available through the Gibson Committee which was organized to take care of people deprived of employment by the depression. By examining a great number of these individuals it was possible to single out a few with training and background suitable for the type of work involved. With the aid of these people the work was carried forward for about a year. At the same time very extensive plans were made so that if a large staff later became available the undertaking could go forward effectively and smoothly.

When the Federal Government took over the administration of work relief, an application was made for a project to carry on this research on the literature of Foraminifera. This request was granted, and in January, 1934, a staff of eighty-two people was assembled. After a year had elapsed, a critical study of the results was made, and on the basis of this study a new grant was made in August, 1935. This grant provided for an organization of two hundred people and the necessary supplies and equipment to carry on this complex undertaking. Great progress was made during the next twelve months, and at the end of that time arrangements were made to carry on the work for the additional year necessary to complete the task. The undertaking is now going forward under this present grant, and it is estimated that the manuscript will be ready for the publishers by the fall of 1937.

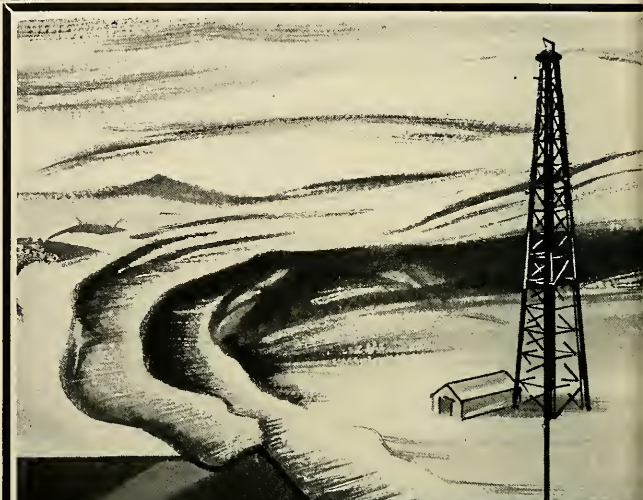
Twenty-five volumes

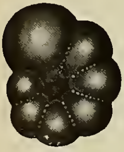
In this undertaking, the original description, the type figure, locality and level, and other important and significant data relating to each species of Foraminifera is being assembled, integrated and cross-indexed. In addition, all subsequent references are being assembled and appended to each species in chronological order. The same general treatment is given each genus so that both species and

(Continued on page 442)

The Master

First glimpses of the tremendous plan now nearing completion which will enable the petroleum geologist to utilize to their full capacity an



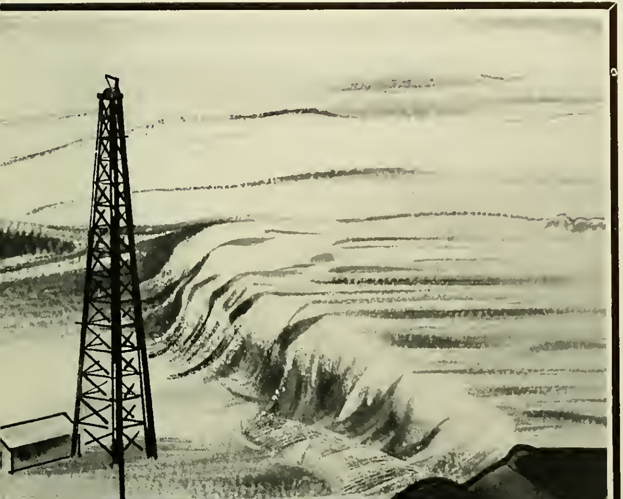


Since the days *when oil prospectors believed in the divining rod, science has developed extraordinary methods for locating oil. The latest and most effective is the use of microscopic fossils known as Foraminifera, which speak to the geologist in terms of buried rock structure*

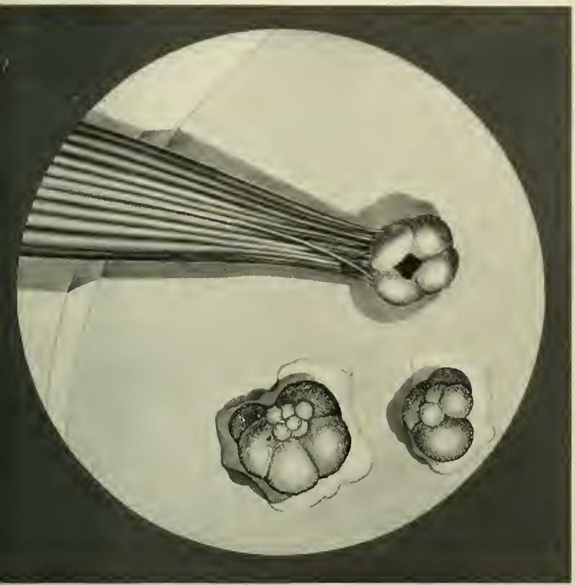
Index "Forams" from drill samples, such as are shown on this page, establish the position of the various rock layers in the geological time

Key to Oil

incomparably valuable set of clues in his search for oil



scale, and without actually denoting the presence of oil, enable the prospector to carry his search in the direction of oil-bearing beds. More important still, samples from adjacent drillings reveal the existence of buried folds or domes in the rocks, like the one illustrated above in cross section, in which oil and gas are likely to accumulate. Because oil floats on water, it occupies a high portion in the "trap" shown in this diagram, with the natural gas filling the space at the top

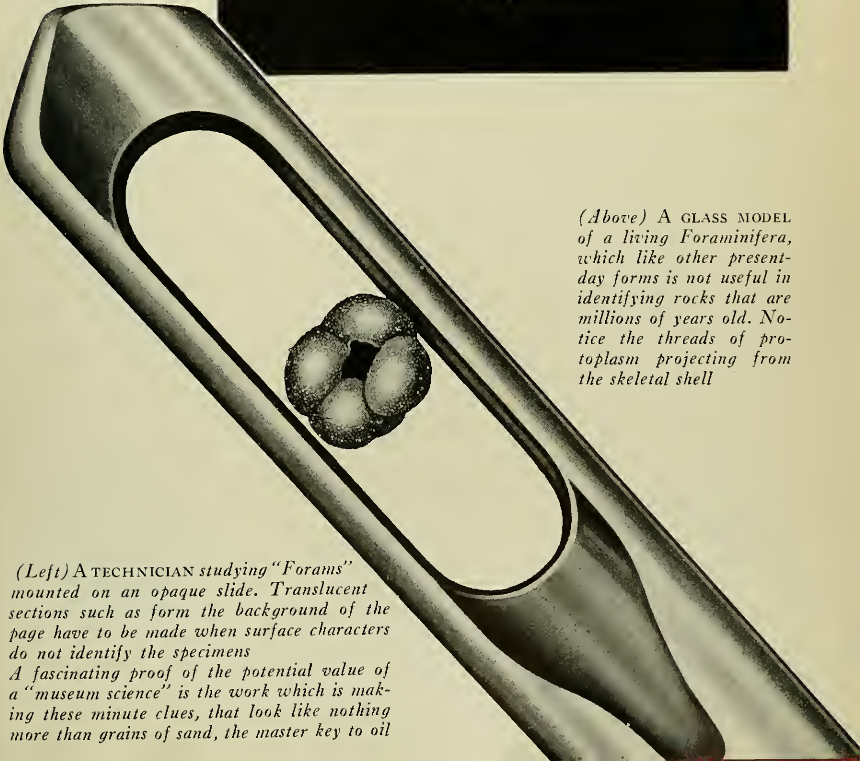


THE CATALOGING of the 12,00 species of Foraminifera by th Geological Research Projec under the directorship of Dr Brooks F. Ellis will provide th petroleum geologist with a 25-volume encyclopedia of these fossils, so important in the search for oil

FROM A WASHED SAMPLE *of pulverized rock, shown highly magnified at left, the laboratory technician picks out significant specimens of Foraminifera for mounting and study. The sorting stage of the microscope both rotates and travels horizontally to facilitate selection. As shown above through the microscope the moistened tip of a brush is used for transferring the specimens to the mounting slide on which they are glued*

(Right) AN INDEX FOSSIL *greatly enlarged. This drawing, like the others accompanying this article, shows the artistic precision that the W.P.A. artists connected with the Project have had to exercise*

(Below) ONE OF THE SMALLER *Foraminifera, placed in the eye of an ordinary needle to show its small size*



(Above) A GLASS MODEL *of a living Foraminifera, which like other present-day forms is not useful in identifying rocks that are millions of years old. Notice the threads of protoplasm projecting from the skeletal shell*

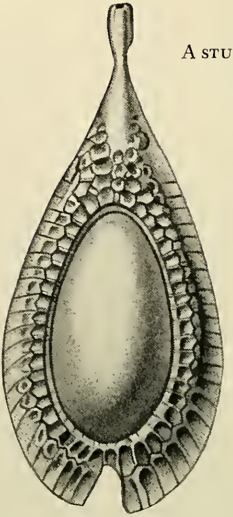
(Left) A TECHNICIAN *studying "Forams" mounted on an opaque slide. Translucent sections such as form the background of the page have to be made when surface characters do not identify the specimens*

A fascinating proof of the potential value of a "museum science" is the work which is making these minute clues, that look like nothing more than grains of sand, the master key to oil

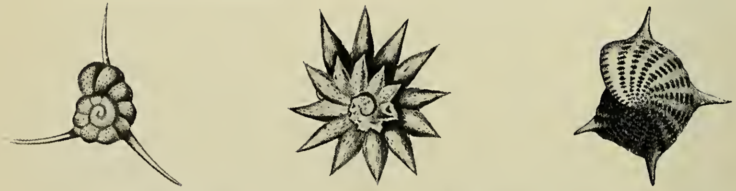
Art Under the Microscope

A study of typical "Forams"

The rôle of "Forams" in art: aside from their vital importance to paleontology and stratigraphy, this type of tiny organisms constitutes a fascinating study in the fundamentals of aesthetic design

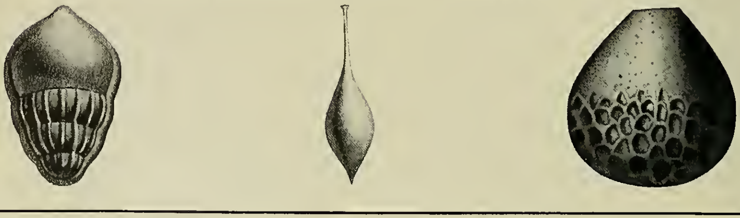


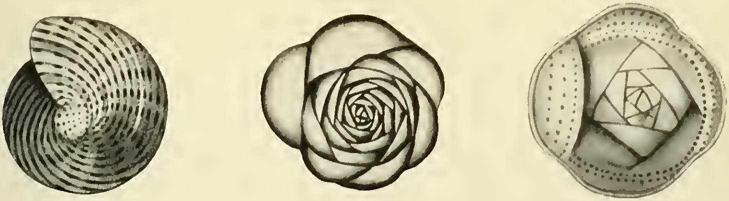
Pendant "Foram": a striking drawing by the W.P.A. artists on the Geological Research Project. These microscopic organisms are of great interest to designers because of the variety of basic aesthetic forms



Starlike "Forams": unusual evidence of their varied formations

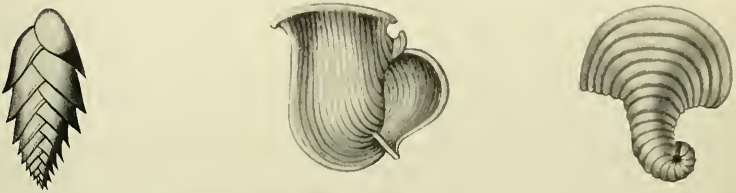
Nature's acorn motif; drop-like "Foram"; and a gourd "Foram"



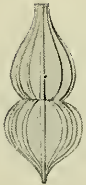


Spiral "Foram" and two types of the rosette structure

The cone, the bell-like contour and the cornucopia design



All these "Forams" represent Nature's most minute conception of line, form and plane. Faithfully rendered as these drawings are from a scientific point of view, the artists have lost nothing of their distinctive aesthetic qualities



In a great many cases these "Forams" combine two or more basic motives as shown in the above drawing

The types shown on these pages represent only a few of the basic aesthetic forms that are expressed by the 12,000 different species of "Forams"

Air Conditioning in Nature

Showing how our nasal chamber is equipped to cleanse and temper the air we breathe, but less effectively than in some animals

By WILLIAM K. GREGORY
Curator of Comparative and Human Anatomy, American Museum

When we have a cold in the head, one of the reasons why we feel miserable is that our natural air conditioning apparatus has been put out of commission. Evolution through countless generations has developed in the nasal chamber facilities for modifying or conditioning every breath of air that we draw.

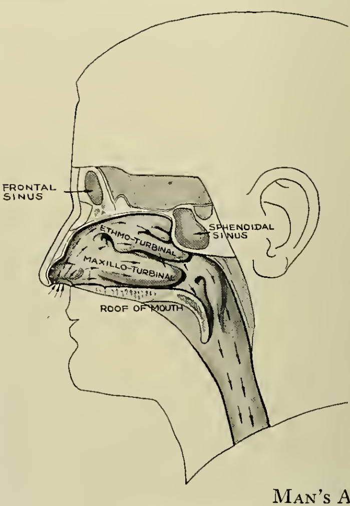
The modern air conditioning machines used in theaters, stores, offices and homes cool and reduce the humidity of summer air, and filter it. A similar service is performed by the nasal passages.

"Radiators"

The air we breathe on a cold winter's day is warmed by contact with a large surface of mucous membrane in the nasal chamber copiously supplied with blood vessels. Though the actual size of the nasal chamber is small, the area of the mucous membranes is comparatively large owing to their being complexly folded, much in the way that the surface of a house radiator is increased by its projecting fins.

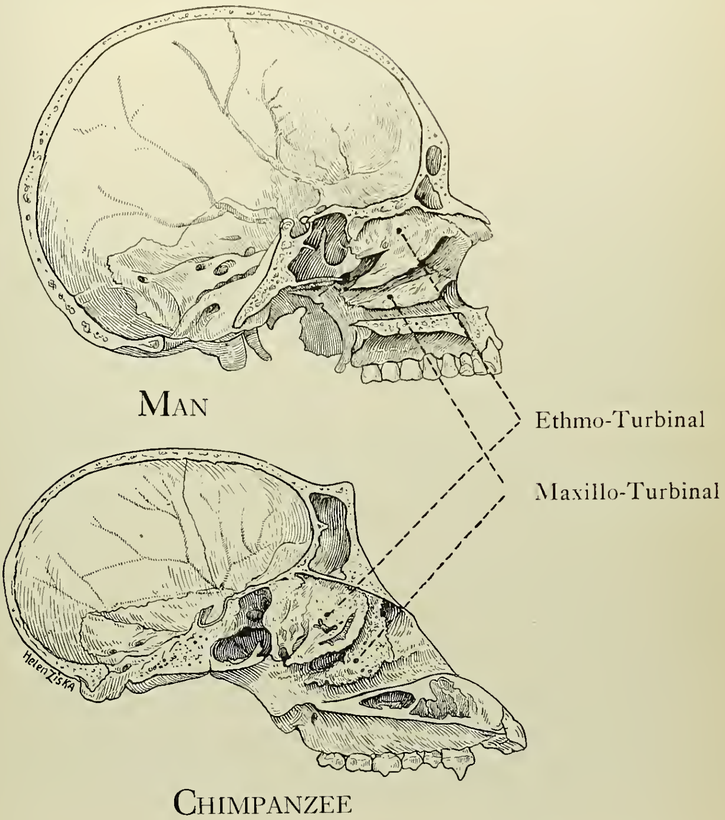
The membranes of the nose are kept moist and in this way are prevented from drying and cracking. The air that is inhaled takes up moisture from wet surfaces in proportion to its own lack of it. The mucous itself also helps to cleanse the air of dust. The foreign particles stick to the mucous membrane and are washed off into the passage that leads to the throat or are blown out through the nose. Thus the nasal chamber warms, moistens, and cleanses the air we breathe. The brain is further protected from extreme cold by the sinuses or cavities which separate it from the cold air that strikes the face and is inhaled.

Man is not as well equipped for the function of air conditioning, however, as many of the lower animals. In certain mammals, such as the members of the family including the badgers, weasels, skunks, mink, otters, etc., the nasal membranes are particularly well developed, and the air that is drawn into the nasal chamber and passes through its "radiators" is



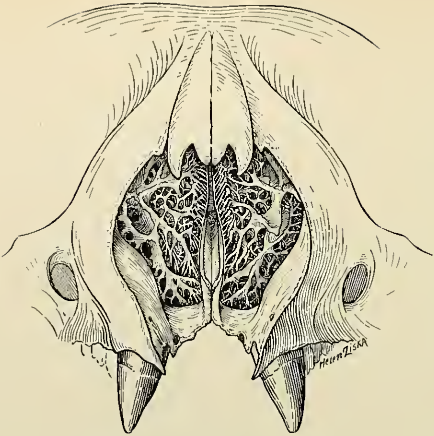
MAN'S AIR CONDITIONING EQUIPMENT

The moist membranes of the turbinals, copiously supplied with blood vessels, cleanse the air of dust and warm it in cold weather to a greater degree warmed or moistened by the hot blood that courses through them. Doubtless this lessens the shock of extreme cold air to the sensitive nerves of smell and prevents undue congestion of blood in the brain itself. In man as well as other animals the membranes are supported by delicate shell-like bones called turbinate bones or turbinals, of which there are two groups. The membrane which is attached to the upper and inner turbinals (ethmo-turbinals) is the seat of the smell-detecting organs; whereas the lower and forward membrane is devoid of smelling organs.



MAN AND CHIMPANZEE COMPARED

The complexly folded membranes of the nasal chamber are supported by the delicate, shell-like turbinate bones. In the form and arrangement of these nasal "radiators," man most closely resembles the gorilla and chimpanzee, whereas in some of the northern fur-bearing animals the turbinals are much further developed

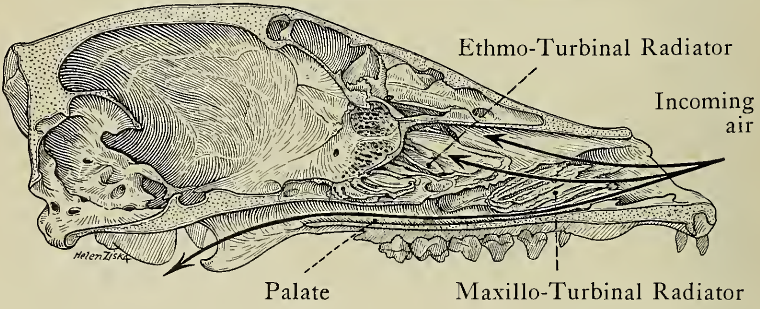


Especially in the seal does the air conditioning apparatus reach a high development, as is apparent from the accompanying drawing showing the complex network of the forward turbinals

The fact that the scrolls of the turbinals are much more complexly folded in most mammals than in man and present a greater surface to the incoming air is doubtless one of the causes of the superior smelling power of the lower animals. Man, as a rule, is far inferior to them in the delicacy of perception of smells.

Man most nearly approaches the chimpanzee and gorilla in the form and arrangement of the scrolls. These tropical animals possess a nasal air conditioning equipment that is much closer to man's than is that of the northern fur-bearing animals. It is in the latter that the air conditioning apparatus reaches its peak. Especially in the seals are the forward turbinals (maxillo-turbinals) well developed, as can be seen by a comparison of the accompanying illustrations.

Doubtless man's poor equipment in nasal air conditioning apparatus is one of the reasons why either cold or very dry and hot air is so unpleasant in the human nasal chamber and why well-conditioned air is so welcome to us, both in summer and winter.



Perception of Smell

A reason for the superior smelling ability of many mammals is seen in their complexly folded ethmo-turbinals, which are the seat of the smell-detecting organs. The drawing above shows how these turbinals are well developed in the keen-scented coati, a racoon-like animal

Fleischmann-Clark, American Museum, Indo-China Expedition

An Expedition into the remote and little known countries of Indo-China and Annam to secure some of the interesting and comparatively rare zoölogical specimens

Photographs by
James Lippitt Clark

SAIGON. *The Expedition members found this city of far-eastern Indo-China a miniature Paris even to its flower markets. Broad boulevards, lined with modern buildings and rows of shade-trees, and narrower streets with attractive French shops and side-walk cafes, dispelled thoughts of the jungle just beyond. Strictly modern docks and warehouses handled efficiently great shipments of rice, rubber, lumber and other products of the country*

SORTING AND PACKING EXPEDITION EQUIPMENT. *From civilization the Expedition struck north into the back country where they established their field camps and did their collecting*

TRAVELING *as far as they could go by auto they transferred all equipment to the bullock carts of the Mois and bumped along over native by-ways through jungles to the game fields*

Base camp *was established in a tropical setting on the banks of the Lagna River. Here tigers roamed the jungle and fresh tracks were seen daily sometimes within a hundred yards of the camp*

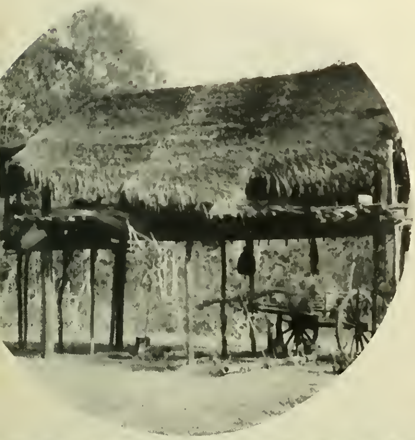
Although roaming herds *of elephants often passed by their encampment and serenaded them as they supped in their open air dining room they dined well with French cooking prepared over a fire built in a hole dug in the ground*

LOCAL NATIVES, THE MOIS, *the aborigines of the French Indo-China country were recruited as guides and porters. They lived on the river bank by the camp under the shelter of simple structures of bamboo and palm leaves*

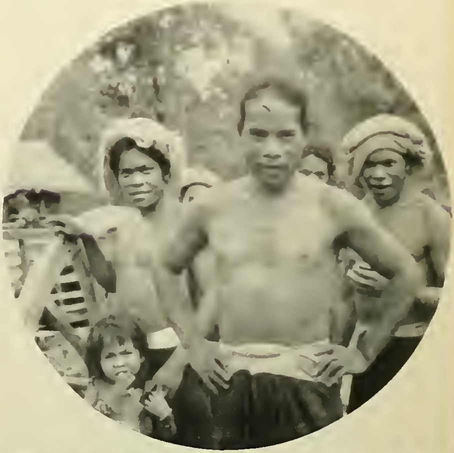
Life in a Moi Village

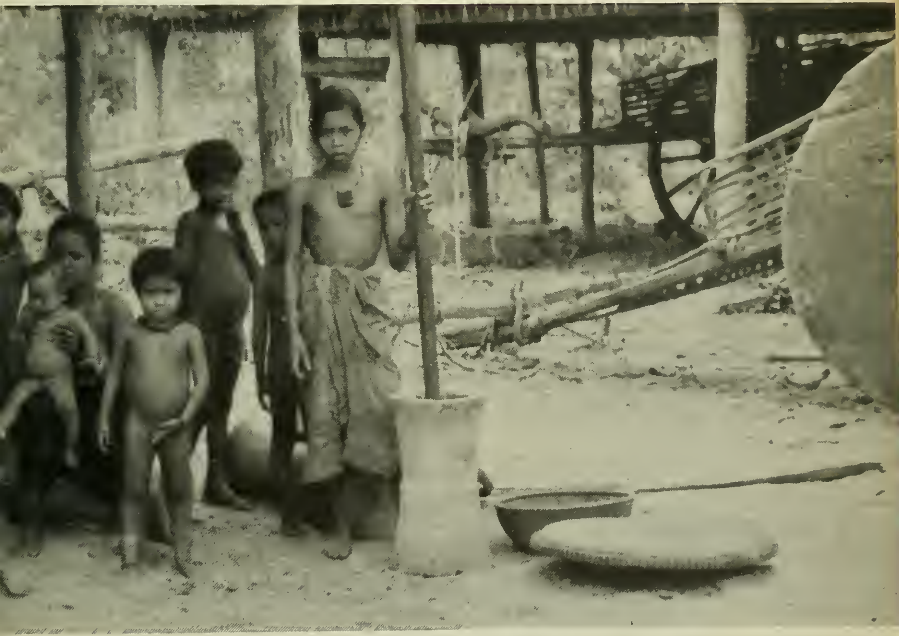
WOMEN AND CHILDREN OF THE MOI. *Like most native tribes the women and children tend the garden, gather the crops and grind the rice while the young boys herd the stock. The men hunt and fish or lumber the big trees and sell hewn logs to the white men*

Native villages of the Mois *were scattered through the surrounding country. Within such a compound several community houses are built on high stilts as protection against tigers, snakes and floods*



Moi men in their village compound. *The Mois are of Malay extraction. They are primarily rice eaters, clearing forest areas and tilling the soil for rice paddies. As there is no irrigation they depend wholly upon the rains*





FLEISCHMANN-CLARK, AMERICAN MUSEUM, INDO-CHINA EXPEDITION

MOI PORTERS PREPARING SPECIMENS TAKEN BY THE EXPEDITION. *Complete specimens of the Asiatic water buffalo, the Saladang or Guar-ox and the wild-ox called the Banting were secured as well as many lesser animals. Birds, reptiles, fish and other interesting specimens, also swelled their collection*

DR. CLARK AND A FULL GROWN MOUSE DEER *collected by him while night hunting. This, the smallest of all deer, stood only eight inches at the shoulders and weighed but four pounds. When skinned it was found to contain a full grown embryo which was preserved and added to the collection of valuable specimens*

(Lower left) AN ANNAMITE VILLAGE STREET. *The Annamites, the "civilized" people of Annam, are of Mongolian extraction and build adobe houses of quite pretentious design and detail. They too live principally on rice; but do not intermarry with the Moi*

(Lower right) MAJ. MAX C. FLEISCHMANN, INTERNATIONAL SPORTSMAN AND BIG-GAME HUNTER *sponsored the expedition and through his tireless efforts in the field secured many of the expedition's most valuable specimens*

The Conquest of the Air

Nature's achievements in the air compared with man's: the story of flight from prehistoric times to the present

By WILLY LEY

Drawings by George F. Mason

ONE sometimes reads that the conquest of the air was first made in 1783, when the Montgolfier brothers in France filled for the first time a big bag of paper with heated air. Needless to say this is the statement of the engineer, not of the natural historian.

As a matter of fact, it could be argued that the Montgolfiers were certainly not the first men to attempt to fly, and it is even doubtful whether they were the first to succeed. Then, it has to be stated that the assumption of the engineers that there are only men and machines on earth, is wrong. The flying animals and also plants existed for hundreds of millions of years before the appearance of man.

Lessons from Nature

The real assertion we must make about human aviation was expressed as early as about a thousand years ago with the short sentence *"Natura Artis Magistra,"* Nature is the master (teacher) of the arts. If there were no flying animals man might never have thought of flying.

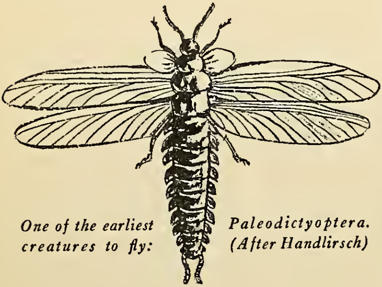
Natura Artis Magistra must not be misunderstood. Man does not follow Nature exactly. Any attempt to copy exactly is bound to fail for the perfectly logical reason that we do not construct on the same scale and with the same materials used by Nature. There are inventions that work satisfactorily when demonstrated with small models, but when built on large scale in exactly the same proportions, they fail to work, because the ratio between stresses and strength changes with the size. A dragon-fly seems a perfect airplane, but if it had the dimensions of a real airplane it would break to pieces if it only tried to beat its wings. There was a short period in the development of the railway, when engineers tried to imitate the legs of a horse on the locomotive. These experiments, which seem ridiculous to our knowledge, had soon to be abandoned. Their inventors had not learned from Nature but had tried to imitate Nature exactly, just as did some of the first inventors of airplanes when they tried to make them beat their wings.

Principles

There are widely differing ways in which flying is achieved, both in Nature and in human aviation. A zeppelin flies and a China clipper flies, but the principles are not the same. Likewise the flight of the swallow and of a flying squirrel differ in principle.

Basically there are two main types of flight, (1) the flight of "heavier-than-air" bodies (also called dynamic flight or real flight); and (2) the flight of "lighter-than-air" bodies (static flight or floating flight). Balloons, stratosphere balloons, sounding balloons and airships operate under the second principle, owing to the fact that they have a huge bag filled with a gas that is lighter than air. If the craft has propellers they are used mainly for horizontal movement.

The airship type of flying does not occur in the animal kingdom. But plants have taken advantage of the fact that heated air is lighter than cold air and tends to rise. There is a pine tree in Europe, the German *Kiefer*, which grows in great abundance in Northern Germany, especially in the province of Brandenburg around Berlin. On calm, warm days one can observe big yellow clouds, hovering just above the tree-tops of the forests. These clouds are dust clouds, composed of myriads of tiny particles of pollen. Every one of these pollen particles has two microscopic bags of skin attached to it, filled with a small quantity of air. When the sun's rays strike the pollen (in the open male flowers of the tree) the air in the little skin bags is heated, it expands and, being warmer and lighter than the surrounding air carries the pollen upward. If there is no wind to blow them away they float above the forest all through the day until sunset comes. Then the lifting power of the air bags diminishes and the pollen begin to float gently downward. Billions and billions miss their destination and die, but a few of them fall on the open female flowers of the trees and grow into seeds. The latter, incidentally, are later capable of another kind of flight, having adopted the twirling autogiro principle used by the seeds of elm and maple trees.



One of the earliest creatures to fly: Paleodictyoptera. (After Handlirsch)

The other method of flying, that of heavier-than-air bodies, includes three methods, namely, gliding, soaring, and true flying. A fourth method has been added recently by man, the reaction principle, which makes powder-filled sky rockets as well as scientifically designed liquid fuel rockets shoot up into the sky. But here again, *Natura Artis Magistra;* there is nothing really new under the sun. The squid and all other Cephalopoda, along with most jelly-fish (*Medusa* and *Siphonophora*) swim by this same principle, though it has not been utilized in the air by any animal.

Actual flight differs from soaring and gliding mainly in one respect: it requires power, muscular power or engine power, as the case may be. Gliding (powerless) flight in still air can never attain altitudes above the point of departure; powered flight can. Powered flight produces artificially, either with beating wings or by means of a propeller, a stream of air which enables the body to move not only horizontally but also up and down. Whether the machine is an ordinary airplane, an autogiro or a helicopter does not matter, all are in this respect applications of the same principle.

While we know exactly when and where powered free flight with a heavier-than-air plane was successfully made for the first time—it was the flight of the Wright Brothers' "strange contraption" at Kitty Hawk—it is somewhat obscure and doubtful when Nature succeeded for the first time in the same task. We can only judge from the fossils we have found, and these tell us that the first real flyers on earth were certain insects of the Carboniferous Period. Among these were what may best be described as gigantic dragon flies, which attained a wing-spread of about seventy centimeters, almost thirty inches! Actually they are only distantly related to our present-day dragon flies and had many radically different features. Then too there were the curious Paleodictyoptera which had evolved three pairs of wings. All insects have three pairs of legs when adult or else have lost them through degeneration. They never had more. But the wings apparently did not follow the rule of

A prehistoric flying reptile: Pterodactylus three pairs. Only the Paleodictyoptera had "full wing equipment," butterflies and dragon flies have two pairs of wings, other insects show only one pair or none, and a few like the common fly prove that there was once a second pair which has degenerated. No insects, either living or fossil, were ever known to possess a trace of a third pair of wings until these Carboniferous fossils came to light. They show the original third pair very distinctly; but they also show that it was already degenerate in those times.

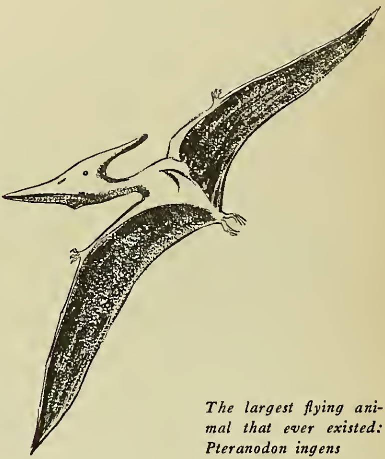
The other branch of true flyers of today are the birds, whose ancestors were presumably the flying reptiles of the Jurassic Period. The feathers of birds are nothing but the modified scales of their reptilian forebears, their wings the changed fore-limbs of tree-climbing animals. When certain prehistoric lizards developed wing-like membranes they became what we call Pterosauria or flying lizards.

We know the fossil remains of many dozens of different types and varieties of pterosaurians, ranging in size from a sparrow to an eagle. One kind are called the Pterodactyli ("winged-fingered creatures") from the fact that the wing-membrane extends from the tip of a greatly elongated fourth digit, along the back of the arm and the side of the body. Its mode of life was probably very much the same as that of the bats of today; the large eyes of many ancient varieties even indicate that they flew chiefly in the dark or at least in twilight. The severed species of the genus known as the Rhamphorhynchus are more slender and are equipped with a long tail at the end of which is a curious little leathery "rudder." Many scientists call this type a "reptilian sea gull" and believe that it lived mainly near the seashore and fed on fishes.

While the Pterodactyli and the Rhamphorhynchi were primarily European types and belonged for the greater part to the Jurassic Period, America had produced the remains of the largest flying animal that ever existed. This was *Pteranodon ingens* (the "giant toothless flyer"), which has been found in the United States in the so-called Niobrara layers of the Cretaceous Period. *Pteranodon's* wingspread was enormous, up to an estimated 21 feet. At the time when it existed parts of the present-day United States were covered by a sea, known as the American Niobrara Sea, and it was over these waters that *Pteranodon* flew in search of fish for food. *Pteranodon* was a short-tailed type, but it nevertheless had its "rudder" attached curiously enough to its head in the form of a long bony keel-like ridge on the back of the skull.

The third group of active flyers, the bats, appeared on earth much later than the birds.

A curious little leathery "rudder" aided the extinct Rhamphorhynchus



The largest flying animal that ever existed: Pteranodon ingens

Fruit-eating bat

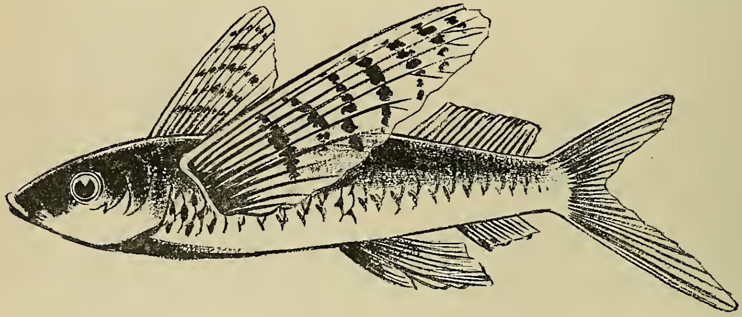
They evolved during the Tertiary Period, when the pterosaurians were already extinct. These three groups of animals, pterosaurians, birds and bats represent three different ways in which the fore-limbs have developed to form wings. While two of the original five fingers of the birds grew together and provide only the "leading edge" for the stiff feathers that form the wing, in the case of the bat four of the fingers grew out of all proportion, so that they form the skeletal structure of the menbranous wing. The pterosaurians also used skin as the material of their wings. But this skin was spread from only one finger, the fourth finger, which grew as long as the arms and the body of the animal together.

Why we have not been able to construct airplanes that beat their wings is easy to explain; they are much too large for this principle of operation. For other reasons no flying animal ever developed a propeller. We have the negative analogy that Nature never developed the wheel. Among Nature's building materials are blood vessels and nerves. These materials are unsuited for a wheel-like organ because they would be twisted around each other and torn off at the connecting point. This obstacle is circumvented in mechanical construction, but with the living tissue as material it appears to be impossible.

With the exception of a little crab all gliders are vertebrate ("backboned") animals and there are representatives of them in all classes. Among the fishes we have the flying (more properly called gliding) fish, which are abundant in all tropical and semi-tropical seas and known to everybody who ever lived in or visited the tropics.

Though there are at least fifty varieties of "flying fish" known and though they can be observed in large numbers on almost any day of the year it has been a matter of lively controversy for many years whether the "flying fish" are flyers or gliders. This controversy is definitely settled now, the flying fishes do *not* fly. Their fins seem to move sometimes, but this is only a quivering motion. The "flight" of fishes is a prolonged jump out of the water which turns into a glide. The large pectoral fins which serve as wings do not beat the air as has been believed.

The fish propels itself under water and jumps out of it with high speed at an angle



Flying fish

which approximates thirty degrees. Once the water is left the large pectoral fins are spread and carry the fish over a considerable distance, "flights" of 600 feet having been reported. That the prolonged jump is no actual flight is evident alone from the fact that flying fishes are never seen in the air on still days. They need wind to fly.

Some observers have reported that their flight shows an undulating motion corresponding to the waves of the sea. This is only natural, for the air currents conform to the curvature of the waves. Indeed, an up-draft will sometimes send a flying fish to the deck of a vessel, where a local calm area causes the creature to drop helpless.

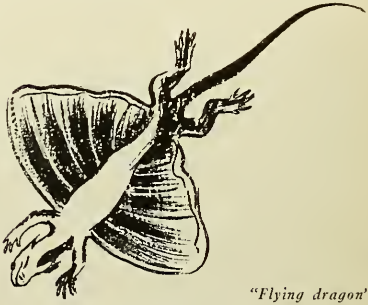
The next class of the vertebrate animals, the amphibians, apparently never made a really successful attempt to conquer the air. Of all amphibians only one makes a feeble effort to rule the air, the "flying frog" (*Polypedates reinhardtii*) of Java. It is a good-sized frog that lives in the tops of the trees and actually flies to a small extent by using its enormous webbed feet in a sort of gliding fall. It is conceivable that sometime in the remote future *Polypedates* may improve its aerial tactics beyond this simple maneuver and win a more worthy place among the creatures that have undertaken to master the realm of the air.

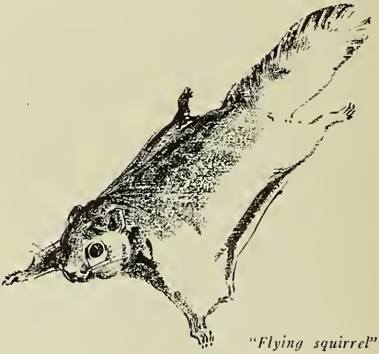
In the same tree with *Polypedates* lives the only flying reptile of today, the "flying dragon" (*Draco volans*). In spite of its formidable name it is only a small and delicately built tree-lizard, about four inches long. Its "parachute" is of a type that bears no resemblance to that of any other animal. From either side of the body a number of ribs extend to form the skeleton for the parachute, the shape of which differs with the variety. Some have triangular parachutes, others semicircular ones.

It is not quite true that the flying dragon is the only reptile of our times that attempts to glide through the air. A snake in the East Indies, *Chrysopelea ornata,* has learned a similar trick. It also lives on trees and while gliding over twigs and branches the snake is able to flatten its body to such an extent that it begins to resemble a folded sheet of paper. In this position, stiffening the body like a stick, the snake can glide through the space between two trees over considerable distances and with high speed.

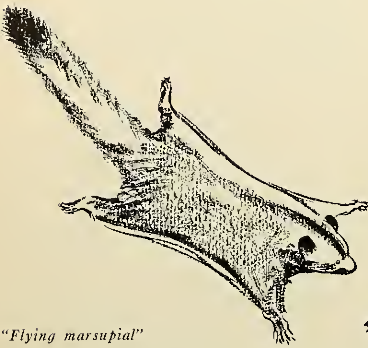
"Flying frog"

There remain only two other classes of vertebrate animals, the birds and the mammals. The study of the flight of birds is complicated, and can scarcely be gone into in a general discussion; and the peculiar wings of bats have already been mentioned. But there are a few mammals besides the bat which have achieved


"Flying dragon"


"Flying squirrel"

a certain degree of aerial ability. They possess a skin stretched out on either side of the body between fore and hind legs, and the long tail acts as a rudder in flight. The flying squirrel belongs in this class. Then there are gliding marsupials, which have developed the same method. And finally there is the "flying lemur," *Galeopithecus,* which looks like a very large flying squirrel. It is not a squirrel, however, and has been classed in a separate order including only one family and two varieties.

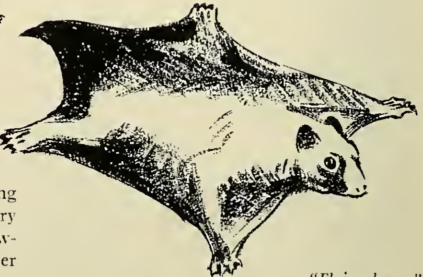


"Flying marsupial"

Galeopithecus leads a life that resembles that of certain tropical fruit-eating bats. During the day it sleeps in the trees, wrapped in its parachute and hanging by all four limbs, like a sloth. When darkness arrives it starts out on its nightly expeditions. It is to be noted that *Galeopithecus* is the best glider of them all, and special muscles in the skin of the parachute seem to indicate that the flight is not absolutely passive.

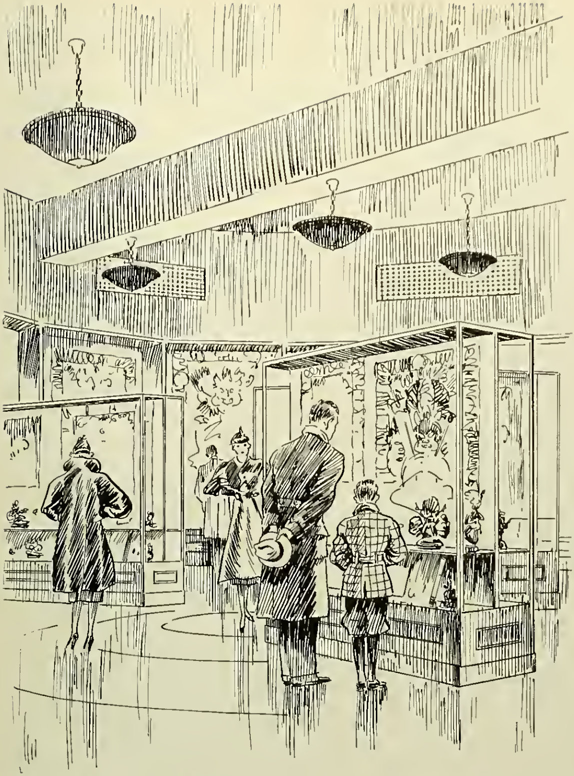
To this long list of active and passive flyers we have to add young spiders of several varieties. They take long air rides on threads spun especially for this purpose. The thread is almost without weight yet it offers sufficient surface in an ascending breeze to carry the rider upwards and enable it to drift. Small spiders wafted along in this manner have been observed on the high seas (Darwin related one case), and it is certainly not by accident that the varieties of spiders that make these flying webs have an especially wide distribution. It has also been observed that small caterpillars make flights of the same kind, either on threads spun by themselves or simply with the long furry hair that covers their bodies. Whether the caterpillars make these flights otherwise than by accident, is still disputed.

The conquest of the air began about five hundred million years ago or more, when the possibly Devonian ancestors of the Paleodictyoptera started flying. And the conquest has continued all through the geological ages and is still going on. Man has observed the methods used by the animals, and has imitated them. He has modified the methods, but the flying animal and the flying machine obey the same natural laws. He has succeeded in rising into the air far higher than the birds; and one hesitates to set an ultimate limit on his aerial activities. In horizontal distance the non-stop cruising range of modern airplanes is already greater than that of such hardy migrants as the golden plover, which flies from Bering Sea to Hawaii. But lest we imagine that man has duplicated mechanically all the aerial feats of Nature, let it be pointed out that even the fastest airplanes are possibly not as yet able to surpass the reported speed of certain insects.



"Flying lemur"

NATURAL HISTORY *has the honor to announce the publication in a future issue of an article by Amelia Earhart on the subject of Speed. The article will be an interpretive study of the fastest speeds attained in Nature in comparison with the mechanical achievements of Man*



William B. Whitney Tibetan-Lamaist Collection

Drawn by Frank Swain

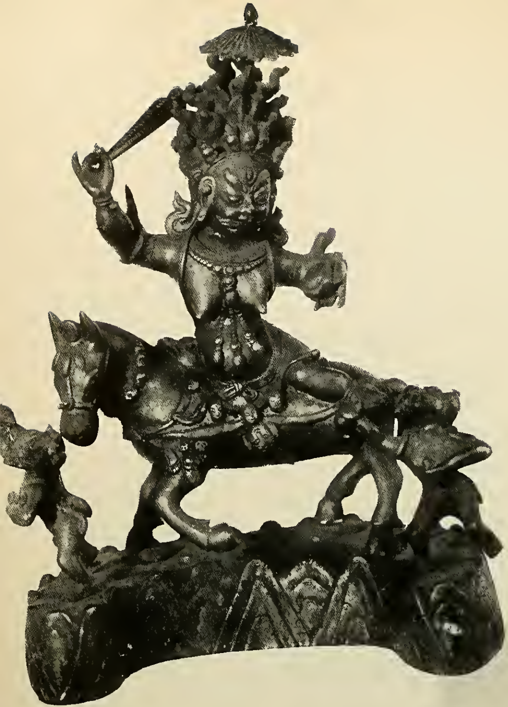
William B. Whitney Tibetan-Lamaist Collection

THE Tibetan-Lamaist Collection which has been gathered together during the last 12 years by William B. Whitney of New York City and is soon to be installed in the American Museum of Natural History is believed to cover the iconography of Lamaism more comprehensively than any other collection on public exhibition in this country, or, so far as is known, in Europe.

The collection comprises nearly 60 painted banners, or *t'ang-k'as,* approximately 400 images, a large number of clay bas-reliefs, and numerous ritual objects and other articles closely associated with Lamaism, altogether more than 800 items. The various articles have been carefully selected by Mr. Whitney, the banners and images especially with reference to their religious symbolism. In addition to the articles exhibited Mr. Whitney plans to give the Museum, whenever a suitable room can be provided for reference and study, the more than 100 banners and other objects completing the collection and a small library of books dealing especially with the subject.

The cataloging and installation have been carried out according to Mr. Whitney's directions by Antoinette K. Gordon, and the Hall will be opened to the public December 15th.

The known history of religion and art in Tibet begins with the introduction of



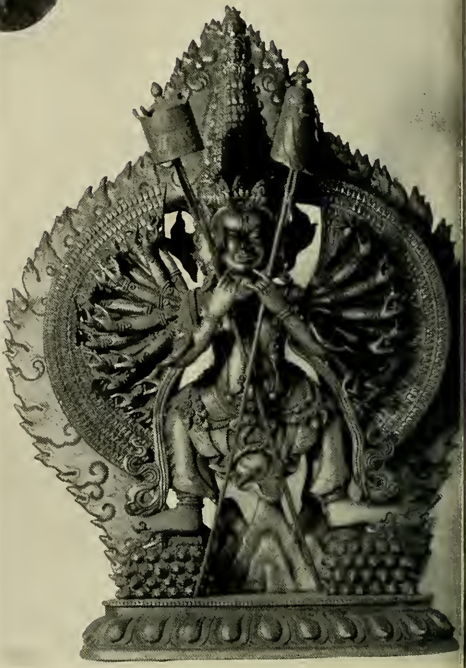
(Left) THE ONLY FEMININE DIVINITY *among the "eight terrible ones": Śri-devī (The Glorious Goddess), a Defender of the Faith of Buddhism*

(Below) WHITE SAVIORESS: *here shown in one of her manifestations called "Uṣnīṣasitātatapatrāparājitā," in which she has innumerable eyes all over her body, symbolizing her omnipresence. She is often called "The Mother of all the Buddhas"*

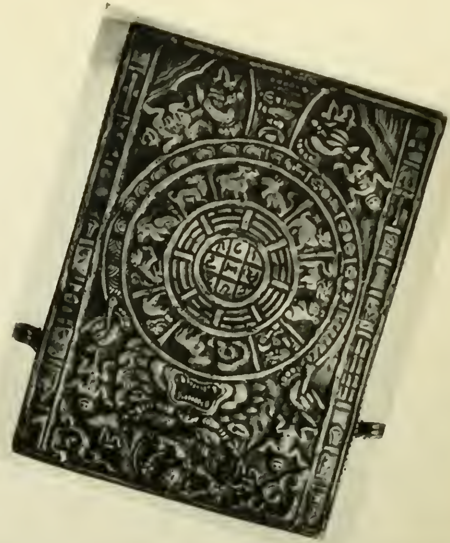
Buddhism in the 7th century. Previous to that time the religion of Tibet was a form of nature worship, Pön demonolotry, carried on by primitive wizard-priests and involving human sacrifices. The Buddhist religion was introduced by the Chinese princess, Wen-ch'eng and the Napalese princess Bhrkutí, both wives of the Tibetan king, Sron Tsan Gampo. In the 8th century succeeding kings sent to India for teachers, among whom Padmasambhava from Nalanda University adapted the primitive deities and rites of Tibet to Buddhism and thus conciliated the Pön priests.

In the 17th century the Fifth Grand Lama of the Established Church, who became the first Dalai Lama, developed the idea of the succession by reincarnation and divine reflexes, which still exists.

Some of the deities represented in the Whitney Collection come from India, specifically the Sivaite deities; others from the indigenous Pön religion of Tibet.

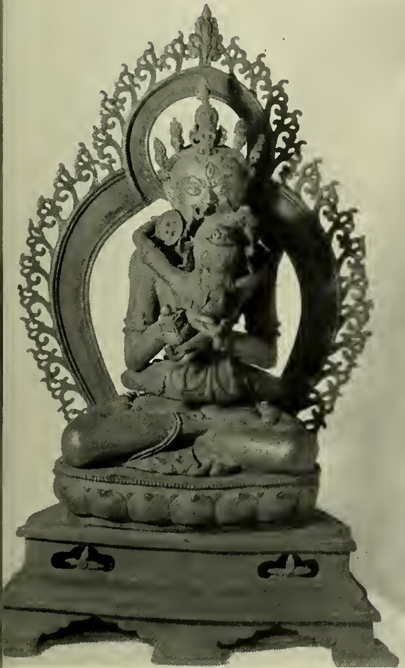


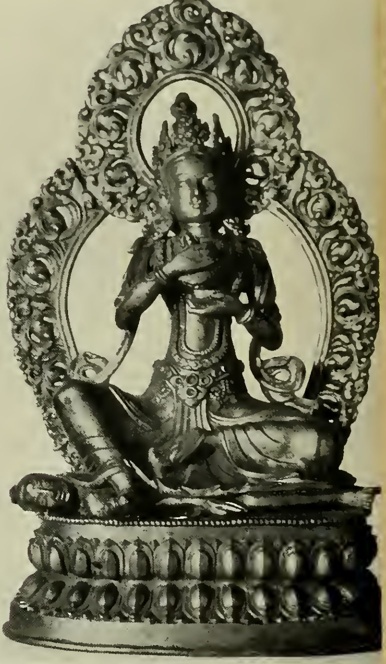
(Right) Horoscope: *one of several methods of divination. The diagram in the center of this amulet box containing prayers is a "magic square," each column of which adds up to 15*

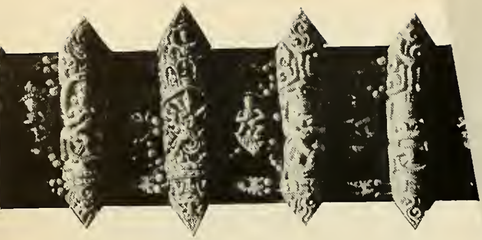


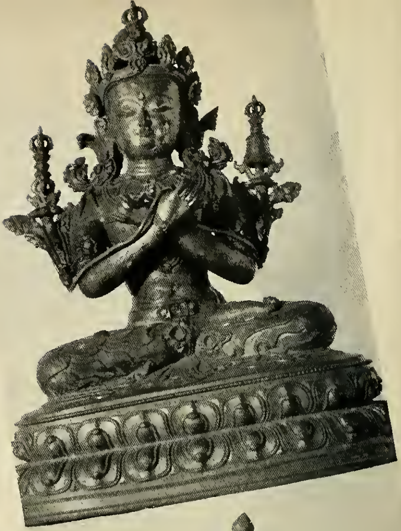
(Below) Sita Saṁvara, *Tutelary Deity with his consort. Every Lama is under protection of a special tutelary. This deity is believed to be incarnate in the Grand Lama of Pekin*

(Lower right) To worship her *brings good luck and destroys all obstacles: Ekajaṭā, a form of the Blue Tara*



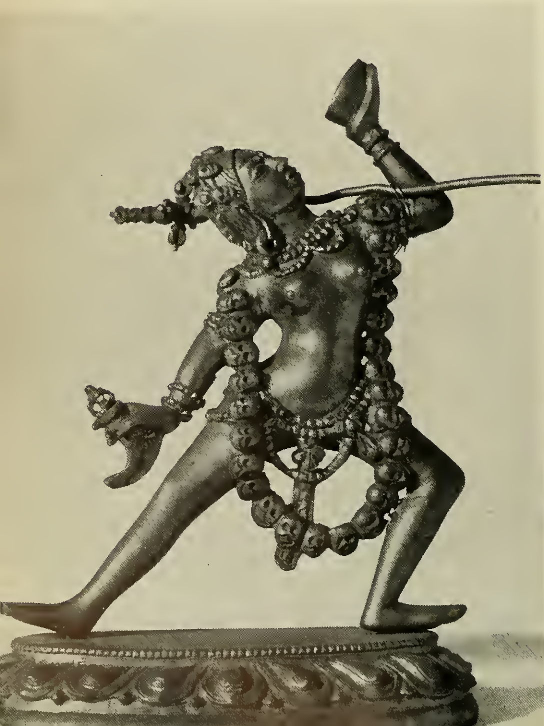


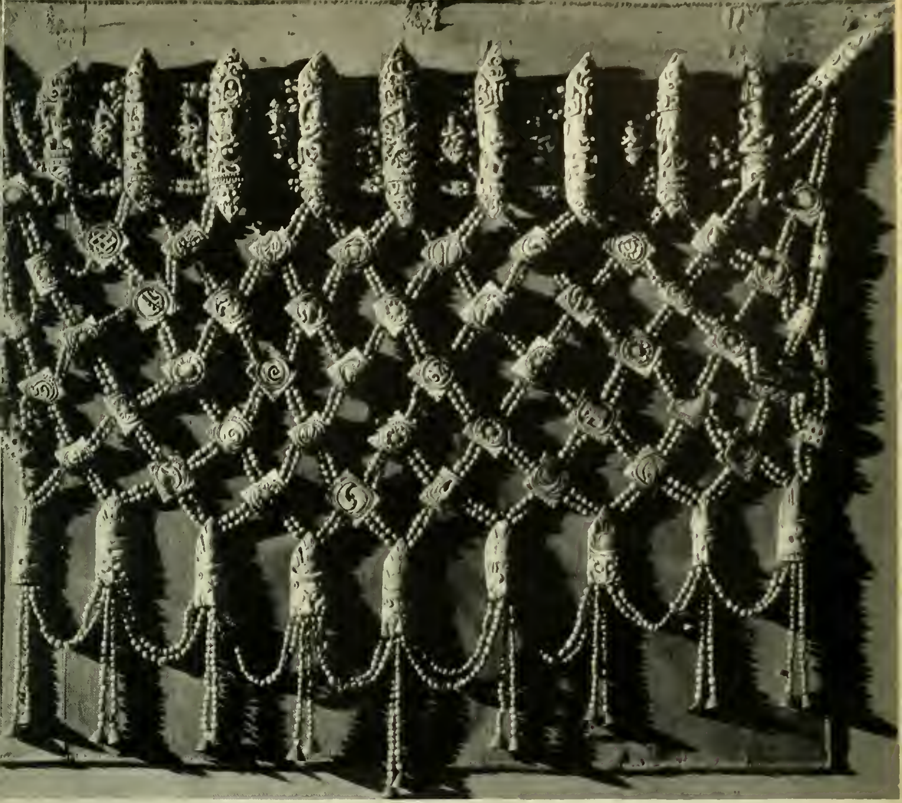




(Right) The primordial buddha *or Adibuddha of the Yellow Cap Sect: Vajradhara, the supreme power and creator of all things*

(Below) Naro who lives in the heavens: *Naro kha chö-ma, a dākinī or fairy, who is invoked for the granting of supernatural powers*



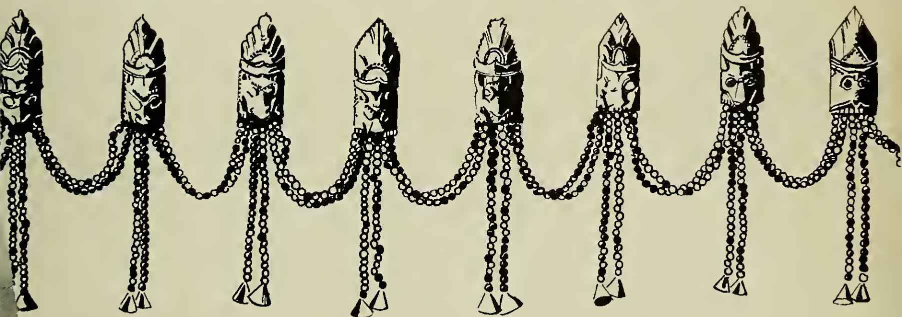


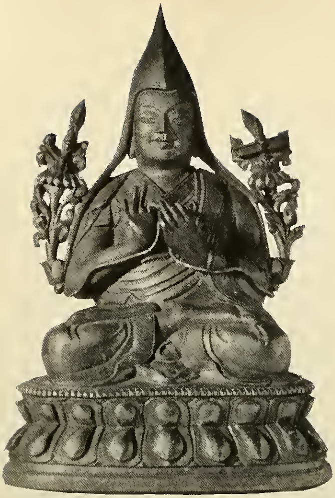
(Left) A DEMON KING *of the old Pönist religion: Dor-je lek-pa, who was subjugated by Padmasambhava, the founder of Lamaism*

(Left) MOST POPULAR DIVINITY *in the northern Buddhist Pantheon. Avalokitésvara, a form of the God of Mercy and Compassion*

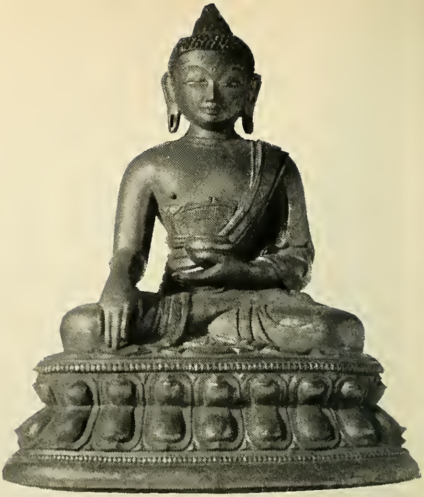
(Above) HUMAN-BONE APRON: *These aprons and other ornaments of human bones are used by the Black-Hat Lamas and sorcerers in their necromantic rites. Usually made from the bones of criminals, they are considered of especially sacred character*

(Below) DETAIL *of intricately carved pendants of human-bone apron*





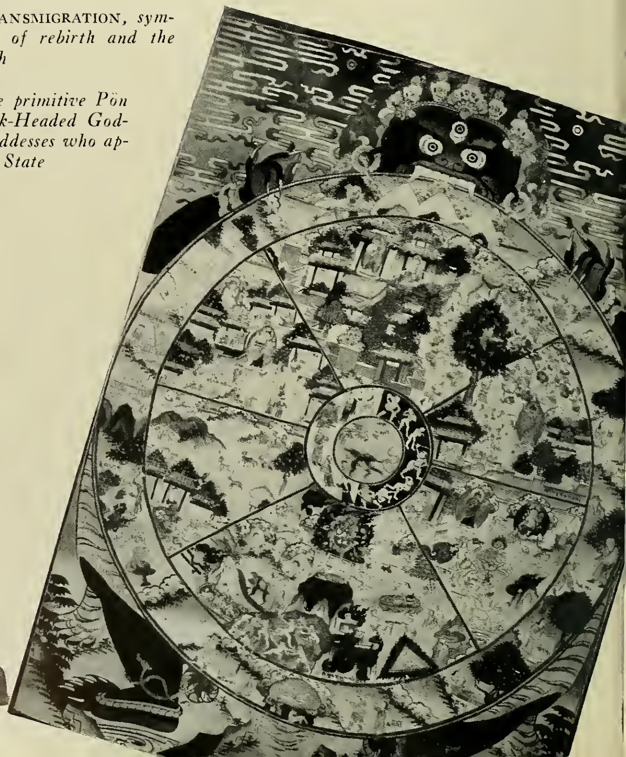
(Above) FOUNDER OF YELLOW CAP SECT, *Established Church of Tibet: Tsong-kha-pa (1357 A. D.-1419 A. D.), a great reformer and teacher*

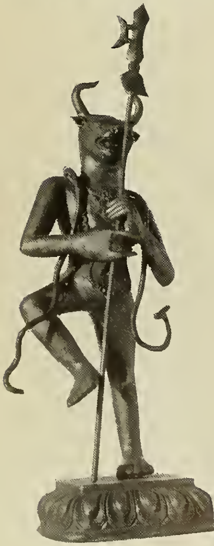


(Above) THE ONLY HISTORICAL BUDDHA *(within our knowledge): Śākyamuni, founder of Buddhism, who preached his doctrine until about 543 B. C. Disciples incorporated his teachings thereafter*

(Right) WHEEL OF TRANSMIGRATION, *symbolic of the six regions of rebirth and the twelve reasons for rebirth*

(Below) A RELIC *of the primitive Pön religion: the Brown Yak-Headed Goddess one of the Bardo goddesses who appear in the After Death State*





The Story of Domestic Animals in America

Nearly all the animals vital to the growth of this continent, from the sheep to Jefferson Davis's camel corps, were importations

By GEORGE G. GOODWIN
Assistant Curator of Mammals, American Museum

IT is no secret that such "zoo" animals as the lion and the tiger are not native to North America and probably never were. That is common knowledge.

What few of us realize is, that nearly all of our "native" domestic animals are not natives of this continent at all, but are among the many things imported into the country by our far-sighted forebears who saw a need for them in the expanding commonwealth.

These animal importations have played so great a role in the building of the United States, that they have grown up as part and parcel of the country. They are "taken for granted." Yet, we repeat, they are importations, and we will herein attempt to tell the tale of how they were brought to these shores.

Native animals

It is unfortunate that the first Europeans to reach America were the rather incurious Spanish, thirsty for gold, who made few intelligent observations of living methods among the American Indians. But this we know, that the Indians had only three domestic animals of any importance: the dog, the turkey, and the llama. The great prairies of the American interior teemed with herds of buffalo, elk, antelope; and the forests and mountains supported great numbers of mountain sheep, goat, and moose. Countless numbers of caribou and herds of musk oxen thrived in the vast barren lands of the Arctic. Yet, in spite of this lavish abundance there was not in all North America, from the Arctic to Panama, one single race of animals that was suitable for domestication.

The red men traveled on foot or by canoe. Nomadic, wandering tribes though they were, they possessed no beasts of burden, no horses or domesticated cattle, and they made no attempt to harness the tremendous power of the buffalo. There is no indication that they even went so far as to take milk from any of the native animals. True, the American Indians did have a dog, the history of which is rather obscure, which was sometimes made to drag the travois, a primitive wheelless luggage frame, and in the sparsely inhabited Arctic the sledge dog was a necessity. But the chief service of the dog to the red man was as a companion or pet, not as an economic asset.

It must not be supposed that it was through lack of intelligence or ability on the part of the red man that he failed to utilize the native animals as beasts of burden. After the introduction of horses it was not long before the Indians were hunting and fighting on horseback. A conspicuous feature in the reminiscences of the early settlers is usually the hostile Indian braves on their piebald ponies. In fact, it is hard to picture the Indians without their horses.

First cattle

No trace of a native race of cattle of any type has been found in North America. Columbus, on his second voyage, apparently brought the first cattle to America in 1493. The first reliable record on the introduction of cattle into the mainland of America is in a report found in the Spanish Archives at Madrid. It states that Gregorio Villalobos, in 1521, brought a number of calves from Santo Domingo to Mexico, landing them near the town of Vera Cruz. These were descendants of the cattle brought from Spain to the West Indies in the years immediately following the voyage of Columbus.

The Texas long horn, once so spectacular in the Southern states and Mexico, originated from a type found in Spain in the 16th century. They were rather small, of a light brown or dark jersey color, neither good beef animals nor suitable for dairy products. Their hardiness and ability to thrive under barren conditions were their chief recommendations.

When stabilization of the United States Government several decades later encouraged the importation of long horn breeding stock into Texas, it did not improve the status of the long horn. After 1860 the Hereford rapidly and completely displaced the Texas long horn on our Western ranges. Today the Texas stock has undergone considerable change owing, curiously enough, to the infusion of a breed from India.

Zebu blood

The humped cattle of India, known as the Zebu, domesticated in Asia about 4000 B. C., was introduced in South Carolina in 1849 on account of its ability to resist disease, parasites, heat and drought. A few years later it reached South Texas, where it proved its value for crossing with the cattle of western Europe breeding. Now much of the Texas stock contains Zebu blood. They are commonly called Brahmans.

Hogs were brought into the new continent as early as 1525 by the Portuguese who in that year landed some on Cape Breton Island. From here they soon spread to Newfoundland and the mainland. They appeared to have thrived, for 13 years later, Mendoza, in reporting to his sovereign, referred to the favorable condition of his cattle, horses, and merino sheep, which he had imported from Spain. The sheep, he said, had been prolific.

The story of the horse in America is one of the most stirring. The Spanish conqueror Cortez who in 1519 brought the first horses that ever set foot in the New World had only 16 of the animals when he landed at the mouth of the Rio Panuco, and he probably never had as many as 100 during the conquest. Yet the appearance of man mounted on four footed animals struck the Indians with such dread and the handful of cavalry were so effective against the Indian foot soldiers, that the horse was one of the foremost factors in the conquest of the greatest Indian nations.

The great Spanish expeditions that explored the southern parts of the United States were well equipped with horses. While the date of the origin of horse culture among the Indians is speculative, its limits, according to Dr. Clark Wissler, are clearly defined. The horse cannot have reached the Indians before the 16th century and we find it in the Far North in 1751.

Wild horses

In 1541 De Soto carried some of his horses across the Mississippi, and it is generally assumed that the horses abandoned by his men in that year were the nucleus of the wild horses later found west of the lower Mississippi. About the same time Coronado reached the present bounds of Oklahoma from Sante Fe, and Ornate is believed to have visited the Pawnee and Kansas in 1599 to 1601. From Coronado's time on there was a growing trade with the Indians of the Gulf Coast; and, beginning about 1600, trade with the interior with Sante Fe as a base. The Indians of the plains, especially the Pawnee, were so troublesome in their plundering raids for horses that a post was established in Kansas about 1704. It is clear, says Wissler, that the Indians below the Platte and lower Missouri were well supplied with horses by 1682, and there is no reason why many of them should not have had horses as early as 1600.

If the dates for the first mention of horses are tabulated, we have a progressive series northward, beginning with 1682 below the Platte and culminating on the Saskatchewan in 1751. In every case, however, we can assume an earlier date for their introduction.

From the very first the Spaniards were great importers of horses and other domestic animals. In this respect they stand in contrast to the French of Canada, where the first horse was imported in 1647.

The English colonists imported horses early but moderately, except among the cavalier element in Virginia. The first horses imported by the New England colonies came in 1629. Horses spread among the Indians of the Atlantic slope, but it was only in the south that they were numerous.

It seems clear, therefore, that the Spaniards must be credited with the introduction of the horse to the Indians of the plains and the lower Mississippi, both east and west; the greater number of horses must have come from their settlements in the southwest and Mexico.

One of the most extraordinary stories in connection with the introduction of domestic animals into the United States is that of the camel. So far as most citizens are concerned the American habitat of the camel is the zoölogical park. Few realize that this odd looking creature came close to establishing himself as an accredited member of the American animal kingdom.

For desert warfare

A formidable danger to small frontier garrisons and settlements in the southwest was the hostile Indians of the region. Their sudden attacks could not be repulsed by the foot soldiers and cavalry, and their fast ponies easily escaped into the desert where it was impossible to follow them. Furthermore it was impossible to transport army supplies through the rough and arid country with horses and pack mules. Thus, reasoning no doubt that in a desert country the ways of the desert tribes of Asia with their swift moving camels could be adopted, Congress in 1855 appropriated $30,000 to enable Jefferson Davis with Major Henry Constantine Wayne and Lieutenant Davis D. Porter of the Navy as leaders to go to Asia for the purpose of securing camels. Wayne went to England and then France seeking information on the treatment of these animals. He consulted French officers who had used the camel in Algeria, and the details derived from them led him to believe that the Asiatic camels would be more suitable in the American climate than the African camels.

Porter, in command of the store ship *Supply,* proceeded to the Mediterranean to meet Wayne at Spezzia. En route he inspected the camels belonging to the Duke of Tuscany at Pisa, a herd descended from Egyptian stock which had been used in Italy for 200 years. But he concluded that these animals were not suitable for his purpose. Accompanied by Wayne he went on to Tunis, where Mohammed Bey gave them two camels. These they kept on board to study the habits, ailments, and care of the animals.

The next stop was at Smyrna, where they found some fine burden camels, but no dromedaries of the type Davis needed for chasing the Indians.

At Salonica, no camels were to be seen; all had been commandeered for use in the Crimean War, then raging. Wayne and Porter pressed on to Constantinople, and thence to the Crimea, to see what use was being made of the camels in the war. At Constantinople Wayne was disappointed. All the camels available were worthless. The Sultan sent far into the interior for good ones to give them, but Wayne, anxious to go to Egypt, did not wait for them to be brought to Constantinople.

The *Supply* then sailed for Alexandria. Wayne arrived at Cairo in search of a permit to export dromedaries. Permission was, at first, only granted for two, but it was later extended to five. The Viceroy notified him that he would make a present of six camels to the United States, but Porter, on examining the animals offered, found them diseased and refused the gift. The Viceroy laid the blame on his servants and six good dromedaries were substituted. These, with three others, were all that were shipped here. They then returned to Smyrna to complete the cargo.

On February 15th the *Supply* set her course for America, carrying a cargo of 33 camels: 9 dromedaries from Egypt, 20 Arabian burden camels, one young Arabian camel, two Bactrian, one Booghdee or Tuilu. (Wayne defined the Bactrian as the two-humped animal, the Arabian as the one-humped and the "dromedary" was merely a swift Arabian, not a burden animal, the Booghdee or Tuilu as cross breds.)

The health of the camels

Two Turks, one a doctor, and three Arabs were brought along to look after the animals. Some of the Turk doctor's prescriptions were recorded by Porter as follows: for a cold give the camel a piece of cheese; for swollen legs, tea and gunpowder; for skin diseases, cauterize with a redhot iron. One extraordinary remedy for some ailments was to boil a young sheep in molasses and to administer half the boiling mixture down the unfortunate creature's throat; and for other complaints, tickle the camel's nose with a chameleon's tail. The return trip lasted three months. During rough weather each animal had to be strapped to the deck to prevent it from falling and injuring itself.

On April 29, 1856, the *Supply* reached Paso Cavallo, off Indianola, but the sea was too rough to make a landing, and Porter then sailed to Belize and there on May 10th transferred the animals to the Steamer *Fashion* under Major Wayne. Four days later they were landed at Powder Point, three miles below Indianola.

On November 14th, the *Supply* again set sail for Texas with forty-four animals—two Bactrian males; three Arabian males; two Tuilu, cross breds; and thirty-seven Arabian females.

At the end of 1856, Davis reported that in his opinion the experiment was a success. Secretary Floyd, who succeeded Davis, was convinced of the usefulness of camels on the western plains, and in December, 1858, he recommended that 1000 be purchased.

The success of the War Department induced others to import camels. In 1858 a British vessel brought two cargoes of camels for Mrs. Watson of Houston, Texas. In 1861 a San Francisco Company imported 20 Bactrian camels for use in transporting salt in Nevada.

It was in 1861, according to W. M. Davis, Secretary of the Nevada Highway Association, that camel transportation was put into practice in Nevada. The camels were a portion of a herd of Bactrian camels imported to carry supplies to army posts in the arid regions.

Look on an old map of the State of Nevada and you will find a section to the south and east of Dayton marked as "Camel Flat." Other maps give the name as "Campbell Flat." The first-named is the proper description, as this is the place where the camels were herded. These camels were used in the transportation of salt across the desert from Churchill County, in the vicinity of San Springs, to the mining camps of Austin and Virginia City, where immense amounts of salt were used in the treatment of ores by the chlorination process. Some of the camels were used near Virginia City as late as 1876.

Camels prohibited at large

This method of transportation did not prove a success, and the animals were soon turned adrift, but not before the legislature of the State of Nevada had passed an act prohibiting camels from running at large upon the highways. This was in 1875. In July of that year a letter written by Colonel Philip Reade states that he saw a herd of wild camels near Oatman's Flat on the Gila River. A prospector reported in 1925 that he had seen one of these animals ten or fifteen years previously in a wild portion of the state at about dusk, and had the scare of his life at the appearance of the unexpected beast.

When the United States forces left Texas in 1861, the camels fell into the hands of the Confederates, who made little use of them and spent little care upon them. They were turned loose to graze, and some wandered away. The stray camels were heard of occasionally, stampeding horses and ravaging fields, and some were killed and eaten by the Indians.

The last of the camels

Indeed, the last of the wild camels in America met his death in Yuma in 1899, and was eaten by the Indians. The *Evening Star* states, "The venerable beast was one of the herd of camels brought from Asia Minor years ago to carry ore from Comstock mines. So ends the greatest attempt at acclimating foreign animals ever made in the United States."

Another animal which, like the camel, was imported by Congressional appropriation, is the reindeer. In northern sections of Europe and Asia the reindeer had been used as a domestic animal for many generations, but in Arctic America the natives depended upon the wild caribou whose movements were sometimes erratic and whose numbers were subject to fluctuation. Especially the introduction of modern firearms threatened the adequacy of the wild herds upon which the natives were dependent. It was Dr. Sheldon Jackson who on an inspection trip to Alaska in 1890 was principally impressed by the rapidly vanishing sources of food among the Eskimos. Not only was their natural source of food disappearing but what in an Arctic climate is equally important, their clothing as well. Dr. Jackson saw that the United States would soon have to choose between feeding these natives or allowing them to starve to death.

The solution which he proposed involved the importation of domestic reindeer upon which the natives could fall back when wild game became scarce, just as their Siberian neighbors were doing across the Bering Strait; and in 1891 he asked Congress for an appropriation. Congress was not convinced of the wisdom of this project. Private individuals, however, were interested and placed $2000 at Jackson's disposal for the experiment, and the first shipment of reindeer, consisting of 162 head, was landed at Teller, Alaska, in 1892, not far south of Bering Strait. It was not long, however, before the government was convinced of the importance of this project. During the following decade 1118 more reindeer from Siberia landed on the shore of St. Clarence Bay.

An emergency effort in the winter of 1897-98 had a less fortunate outcome. Rumors reached Washington in December, 1897, that American miners in the Yukon Valley were faced with starvation. Congress commissioned Dr. Sheldon Jackson to visit Norway and Sweden for the purpose of purchasing 500 reindeer with sleds, harness and drivers to haul supplies to the destitute miners. Jackson arrived in Europe the following year and purchased 526 reindeer, secured the services of 68 Lapp drivers, and sailed for New York. Only one animal died on the voyage of 24 days, though the trip was rough and the deer were quartered in open pens on deck. At New York special trains conveyed them across the continent to Seattle without loss of a single animal. Their troubles began, however, when the moss brought from Norway was exhausted. There was a delay in securing transportation to the head of Lynn Canal and further delays when they arrived there. Nearly 300 of the reindeer died of starvation before the moss fields at the head of the Chilkat River were reached. The remaining 200 animals were too weakened to endure the journey to the Yukon Valley and the trip was abandoned. The whole herd eventually died, leaving no progeny.

A success

The project of importing domestic herds, however, succeeded admirably. The deer thrived and increased in numbers. Other herds were formed, and today the barren wastes fronting the Arctic Ocean support vast herds. It is estimated that considerably more than 100,000 animals have been killed for food and clothing, and the crisis which threatened the natives has been averted. The Alaskan reindeer industry is now firmly established and its importance to the people of the Far North is greater than that of the great herds of stock on the western plains to the people of the United States.

The musk ox

Latest, but we hope not last, of our imported animals is the musk ox. His is not, however, a true importation; it is rather a homecoming, for the musk ox roamed the ranges of northern Alaska in ample numbers until their extermination about a century ago. On September 15, 1930, a herd of 34 young musk oxen arrived in New York on the Norwegian-America Line ship *Bergensvjord.* They had come from Greenland via Norway, and were destined to continue their journey to Fairbanks, Alaska, where it was hoped they would replenish the land with animal life suited to the rigors of the climate.

At Fairbanks a large enclosure provided conditions simulating the natural wild range of musk oxen. The purpose was to study the possibilities of domestication and breeding, with a view to making greater economic use of areas north of timberline.

This experiment represents perhaps the most recent attempt at transplanting and domesticating an animal.

Each attempt, it cannot be denied, served its purpose. The camel died out rather rapidly, and the Texas long horn has passed from the scene to be replaced by a breed more suitable to a prospering cattle industry. Yet, the camel fulfilled his appointed task. He kept faith with those who launched the bold experiment of his importation, and the long horn tided the early cowmen over a trying period.

These cases of transplanting are not the first instances in history where man has bettered his condition and derived impetus for his projects by the intelligent use of the beasts of the field—nor do we believe they will be the last. Man must, however, have an exact knowledge of the animals and their environment to carry out measures that will be to his advantage. If based on misinformation, his schemes will go awry, and result only in much needless waste and cruelty. It is, in part, to perform this service for mankind that the science of mammalogy exists today—constantly furthering the frontiers of its knowledge.

White-lipped Peccary

This distinguished and generally feared inhabitant of tropical American forests becomes a near neighbor of the naturalists on Barro Colorado Island

By FRANK M. CHAPMAN
Curator of Birds,
American Museum of Natural History

I HAD passed five winters on Barro Colorado Island in the Canal Zone before I saw a white-lipped peccary—locally called *"Puerco del Monte."* The setting was appropriate to the occasion. It was late on the afternoon of March 24, 1931, on a remote, rarely visited part of the Zetek Trail. The ground falls here to make a basin-like amphitheatre set with large trees but with almost no undergrowth; a theatrical kind of place. A light rain was falling, there was no air moving, and the forest had already assumed the impressive possibilities of night.

Just as I reached the rim of the depression the animals made a stage entrance from beneath the trunk of a partly fallen large tree at the right. For a moment I was unable to name them. They seemed much larger than I had expected them to be; and far more impressive than the familiar collared peccary.

A procession

They were traveling in single file and were headed in my direction. I counted seven emerge from beneath the tree and there were evidently others following. Except for a short belt knife I was unarmed. In any event, I was not keen for a closer acquaintance with an animal of *el puerco del monte's* reputation at such short notice. I looked about me for a low-limbed tree but this was not an apple orchard, and a tangle of dripping lianes some fifty feet back on the trail was the only climbable thing nearby. Toward them I gently retreated, so gently that I almost stepped on a peccary who appeared to have been asleep in the lower growth. Although his reactions were the more obvious to ear and eye, I think that mine were more profound, for at the moment I was peccary-conscious and better prepared to respond. Fortunately, he was sufficiently frightened to retire, for his resting-place was between me and the vines which promised safety.

On closer acquaintance these seemed less scalable than at a distance and I decided to defer my ascent until I saw the head of the peccary procession appear above the border of the basin.

A quiet departure

Several minutes passed; nothing happened and as I cautiously returned to my former lookout, the last member of the peccary file was disappearing to the left. How many had preceded him I do not know. I was not sorry to see them depart and sat down on a log by the trailside to enjoy the impressions created by this long-anticipated experience.

In his life histories of Barro Colorado mammals[1] Enders writes of the white-lipped peccary: "This is the only mammal of the Island that can, by any stretch of the imagination, be considered dangerous, and then only under circumstances which are seldom met." As far as Barro Colorado is concerned our twelve years' occupancy certainly warrants this statement, for in only one season during this period has *el puerco del monte* played a sufficiently prominent part in our lives to win the consideration that history accords him.

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[1] Bull. Mus. Comp. Zool., Vol. 78, No. 4, 1935, p. 477.

Of this later, meanwhile our interest in this fellow member of our fauna will be increased if we recall the respect in which he is held by those who know him best.

Sixto Arroyo, or "Mex," a local hunter of wide and high repute, from whom, while our guest on the island, we learned much concerning our mammalian fauna, summed up his general estimate of the white-lipped peccary by saying that "it is always better to leave them alone." In a measure both jaguar and puma, he stated, follow this method, for neither one nor the other will attempt to make a "kill" in a body of peccaries but attack only a single animal or the last one in a passing file. Perhaps for this reason the members of bands attempt to remain closely associated and, when separated, circle about until they are reunited. It is this herding habit, added to its individual aggressiveness and courage, that has won for the white-lipped peccary its place as Public Enemy No. 1 among the mammals of tropical America.

Two kinds of peccaries

When one reads, or hears of hunters who have been treed by peccaries he may be sure that the white-lipped peccary was at the base of the tree. The collared peccary, the other species of this American group, is a smaller, less pugnacious animal which on the island rarely gathers in bands that exceed eight or ten in number. In my experience the collared peccary is diurnal rather than nocturnal, is more evenly distributed and probably more numerous than the white-lipped peccary. For these reasons, of the two, he is far more frequently seen. As I have said, I had been on the island five winters, approximately twenty months, before I encountered a white-lipped peccary, whereas it is a common experience to meet the collared peccary in almost any part of the island. Nevertheless, one always reports the meeting, for after all a peccary is a peccary and until the identification is definite the possibilities of the situation are pleasantly emphasized by attributing to every peccary the habits of the white-lipped.

Once the two peccaries have been seen, and their characters noted, they may thereafter easily be distinguished. The white-lipped is notably larger, has coarser, sparser hair and a whitish band on the lower jaw beneath the eye, from which it is separated by a blackish area. The collared, in addition to its smaller size, is sleeker, more finely and thickly haired, and bears its name-mark as a narrow, rather indistinct band around the body in advance of the forelegs. The presence, or recent passage of either species to windward, is often betrayed by the musky odor emitted by the dorsal gland; this is much stronger in the larger species. Enders speaks of it as "rather pleasant" "when not too concentrated" in the collared, but as a "stench" in the white-lipped peccary.

Although, on the island, the collared is doubtless the more common of the two species, the difference in their numbers is by no means to be measured by the comparative frequency with which they are seen.

My camera flashlight-traps, set on our trails through the forest, by day as well as night, have captured more white-lipped than collared peccaries. Possibly this is due to the former's apparent preference for our trails while the latter use paths of their own making. Or, the collared peccary, traveling chiefly by day, may see and avoid the trip-wire stretched across the trail which, to the more nocturnal white-lipped, is not visible. I have, however, small belief in this theory. Pumas and ocelots, photographed at night, apparently see the fine hair wire connected with the flashlight batteries, for invariably they attempt to step over it, but a peccary makes no effort to avoid the wire and butts into it head on.

Wallowing

The shallow, bowl-like depression on the Zetek Trail, where, as related, I first met the white-lipped peccary, proved to be one of their headquarters on the island. It had evidently been formed by subterranean drainage which found current expression in a fissure about ten feet deep and as many wide at the bottom of the bowl. Here, even in the heart of the dry season, there were evidences of water. Here the peccaries came to wallow with results that suggested a barnyard rather than the heart of a primeval forest. In vain I tried to secure flashlights of the scenes which it was obvious must be enacted at this place. Luck was against me and the season ended without a satisfactory exposure. The following year the little barranca was dry.

My many visits by day to this place showed that it was occupied nightly by the mud-bathing peccaries, but, except on the occasion mentioned, I never saw one there. Nevertheless, we have the report of our then headman, Donato, whose word we never had occasion to doubt, that in August, 1927, white-lipped peccaries gathered in large numbers on the Lutz Trail below the laboratory and its connection with the entrance to the Snyder-Molino Trail. Even if we discount the usually conservative Donato's estimate of "five hundred," it is clear from his statement of the ground they occupied that a surprising number of animals had assembled. It is well known that white-lipped peccaries gather in large bodies but the relation of this habit to their annual life cycle is apparently unknown. Possibly it is in some way connected with their mating period.

Rarely seen

Although Donato's observation has not been repeated, a similar phenomenon might readily occur in the more remote parts of the island without our being aware of it. Four thousand acres of densely forested, hilly, barranca-seamed land will conceal many forms of wild life. During my nine seasons on the island I have yet to see either a tapir or ocelot there, and on only two occasions have I met a puma, though we have reason to believe that all three are not uncommon. Indeed, notwithstanding its proved abundance, in only one season since the spring of 1931 have I seen *el puerco del monte*. Then it violated every law concerning its habits that experience had prompted us to formulate. The instance admirably illustrates, not alone the island's attraction, but also its value as an observation post. Year after year, as we return to continue our studies of its undisturbed life, we find how inadequate and misleading is most recorded knowledge of tropical wild-life based on casual or intermittent observations. Certainly, during the season of 1931-32 we had reason to change our previously formed beliefs concerning the habits of the larger of the two peccaries. Returning to Panama on December 2, of the first-named year, I found that the most surprising fact in the news budget that Donato delivered as we crossed from Frijoles to the island, reported the daily presence of *el puerco del monte* in our home clearing. It was midday, the rest-period for bird and beast, but as the launch slid quietly up to our pier Donato proved his statement by pointing to a small band of white-lipped peccaries grazing in the banana plantation on the north slope of the nearby barranca.

Too interested to do more than watch them, when I decided that the season's activities might as well begin at once, I found that my luggage was already on its tramward way to the laboratory. Hurriedly I followed it up the 196 steps to its destination, extracted a 4 x 5 "Graflex," and returned to the barranca. Then I discovered that a colleague, already in residence, was attempting to film these distinguished visitors in our garden. Without attempt at concealment he slowly approached them up the steep, grassy hillside. The motion-camera at his eye so restricted his field of vision he was not aware that he, also, was being stalked until a charging peccary struck him above the knee. Fortunately, under the force of the blow, he lost his footing, slid down the bank and was thus removed from the danger of further attack. Under the circumstances, I did not envy him an experience which would have been a little strenuous for the first ten minutes of one's return to the field. In place of peccaries I devoted myself, therefore, to photographing Swainson's and Ari-cari toucans from beneath the revised "Shannon Shack." The birds were visiting a nearby papaya to feed on the growing fruit which proved to have been softened by the attack of a fruit-fly. Here was a second novel observation and I had not yet been home, so to speak, long enough to remove my hat.

Failure of food supply

This was my first day of what proved to be a peccary winter. Unusually heavy rains at critical periods during the preceding wet season had apparently prevented the fruiting of certain trees that supply peccaries and other animals with food. The rainfall for the year was 123.30 and for November 30.84 inches, of which 23.82 inches fell between the sixth and tenth of the month. But, whatever the cause, there appeared to be an undoubted lack of forest food. Almendro nuts, for example, a favorite fare of peccaries, were almost entirely lacking. These animals, therefore, were evidently forced to range far for food and to hunt by day as well as by night. That they suffered for lack of nourishment is indicated by the accompanying flashlight of a white-lipped peccary secured near Fuertes' House where the species had not been before recorded. Compared with earlier pictures, made during seasons of plenty, this animal appears to be on the verge of starvation.

It was doubtless this failure of the normal food supply that induced these inhabitants of the wilder parts of the island to visit our clearing to graze on the grasses and grub up our root crops. A young boar and two sows, probably members of the band I saw the day of my arrival, attached themselves to the immediate vicinity of the laboratory, where their presence added in no small degree to our interest in the local fauna. They made their headquarters in the shade of a bread fruit tree where the discharge from a waste-pipe supplied conditions for what looked like an ideal wallow. A foot-path passed nearby but to avoid disturbing our guests it was not used while they were bathing.

On one occasion, at noon, I attempted to make a close up, tripod picture of the trio at rest here, but the male started toward me with so evident a determination to prevent this intrusion on his family life that I deserted my camera. The photograph was secured, however, later in the day.

Feared by other animals

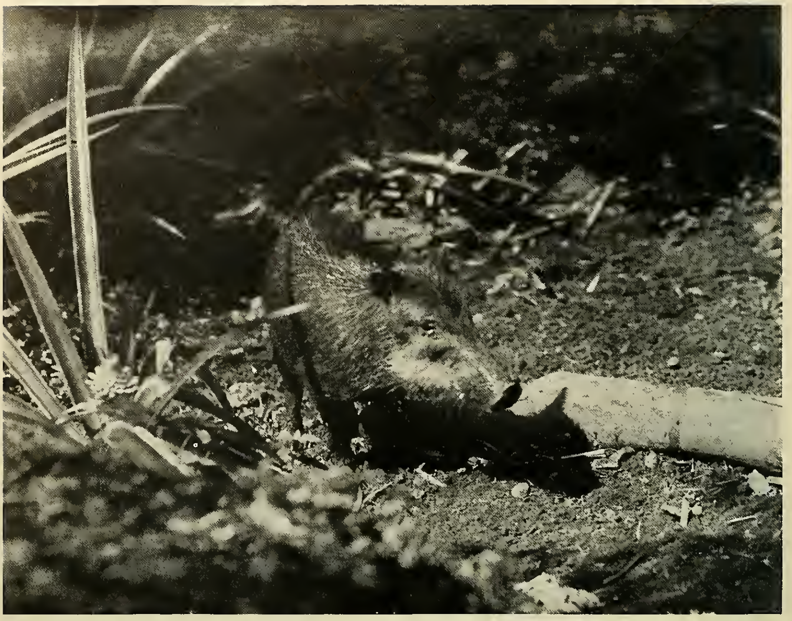
Two native, semi-domesticated members of our household showed a pronounced and evidently instinctive fear of these peccaries. One, an adult male curassow *(Crax)*, was intensely excited by their proximity to his quarters, even though he could perch far above their reach. The other, a usually fearless, mature white-tailed doe, exhibited paroxysms of fright when her nose warned her that a peccary was nearby. Springing to the ceiling of her 8-foot high cage she rebounded to its cement floor with a violence that threatened to break her back. Always we rushed to her rescue.

Unless *el puerco del monte* is at times predatory it is difficult to explain the fear he aroused in these, his forest-mates. An observation made early on the morning of February 1, 1932, seems pertinent. At that time I heard a peccary, probably one of our trio, with whose voices we had become familiar, surprise some creature in the dense growth of the adjoining woods. What followed was typical of many unseen tragedies of a tropical forest—a short chase, capture, agonized screams, silence. I was unable to find the victim.

Returning with my bearer Miguel from a camera tapir-hunt on the morning of January 31, 1932, I found two of our peccary visitors grazing on the hand's-breadth of grass between my doorstep and the forest. Assuming that they would retreat I advanced confidently. But the boar was not disposed to recognize my right of way. With dorsal bristles erect and champing loudly he not alone held his ground but advanced to the attack. Armed only with a butterfly net I, therefore, conceded the post of honor to Miguel, who, besides a Nesbit camera, carried the usual machete. Concealing his elation at our change of positions Miguel, shouting loudly, waved his weapon valiantly and when we were at a distance of about ten feet the peccary reluctantly gave way and permitted me to enter my house. But when, less than three minutes later, I emerged to descend to the laboratory for a shower, the peccaries had returned and were again prepared to dispute my passage. With no Miguel to call on I tossed an empty bottle at the boar. It landed squarely on his nose. He jumped a bit but apparently was neither hurt nor surprised and came back at once to smell of the bottle. Then, indeed, there was a reaction. With a great chomp and squeal he sprang back so suddenly that he knocked the female behind him completely over and continued on his flight to the forest. The bottle, I should add, had contained only water and it seemed evident that the animal had recoiled from the scent of my hand.

Not permanent visitors

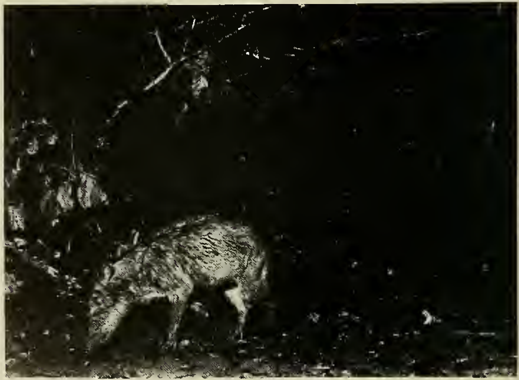
If thus we were at times somewhat inconvenienced by the actions of our nonconformist guests, we realized that their presence offered us an exceptional opportunity to live on more or less intimate terms with animals which, as a rule, man encounters only to kill. Pursuant to Barro Colorado's hospitable custom we, therefore, tried to meet them on their terms with the hope of establishing relations that would be mutually acceptable. But they have never returned, and life about the laboratory now lacks an element of uncertainty that added not a little to its charm.



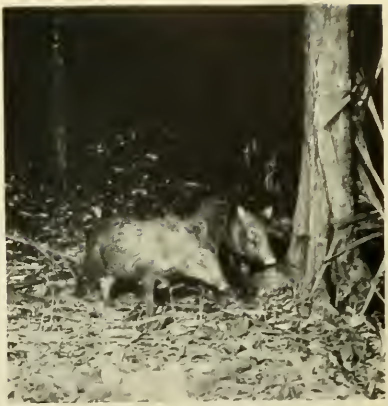
FIVE WINTERS *had passed on Barro Colorado Island in the Canal Zone before Doctor Chapman caught a glimpse of this interesting animal. Unusual circumstances offered the opportunity to live on more or less intimate terms with a creature which man usually encounters only to kill*

White-lipped Peccary

SELF-MADE FLASHLIGHT PHOTOGRAPH. *Failure of the forest food crop apparently brought the peccaries to the half-starved condition shown by the animal in this photograph*

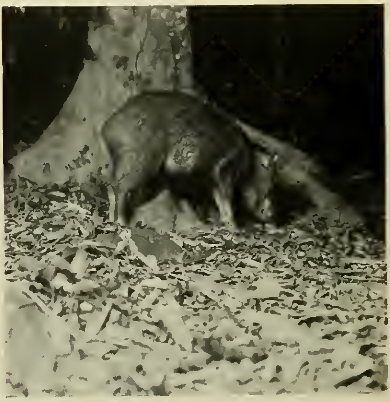


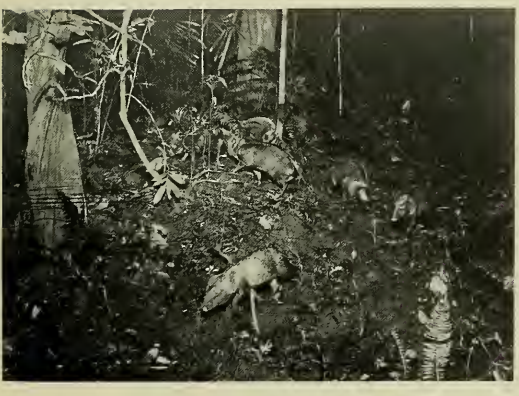
(Right) LESS PUGNACIOUS *than the white-lipped peccary is the collared peccary. Lacking the whitish band on the lower jaw of its larger cousin, the collared variety possesses an indistinct band around the body in advance of the forelegs, visible on the right-hand animal*



Collared Peccaries

A COLLARED PECCARY *on the Wheeler Trail near an almendro tree, the nuts of which are a favorite food of this animal. Note the sleek coat as compared with that of the white-lipped peccary opposite*





A BAND OF SIX *collared peccaries feeding on a hillside. The white-lipped peccary is more nocturnal in its habits, and probably not so numerous which accounts for his being less frequently observed*

Andorra, a Country in the Past

On the border of Spain, where revolution is disrupting the ancient order, one of the world's smallest countries clings to medieval ways

By LAWRENCE FERNSWORTH

Correspondent of "The London Times"

Drawings by AGNES C. LEHMAN

FOLLOW me up the valley of the Valira del Nord through tiny independent Andorra. This scrap of a country, hiding back in the Pyrenees between France and Spain, is like a sample clipped out of the Middle Ages and transplanted in the modern world.

I reach the last cluster of houses in the valley. This is the *cortals* or high mountain village of Llo Serrat, a small settlement that will be deserted in winter. The crude black buildings seem to cling to the rock like so many barnacles. Smoke is coming from the *cabana,* and I knock at the door. The boy who opens it looks startled, but he greets me with an engagingly frank smile and bids me enter.

He was clad in a rough shirt and corduroy pants which came high up his waist. In a few moments he was joined by two younger brothers who came running from the barn. I broke two eggs and fried them over the fire for my breakfast. The boys sat eyeing me shyly. Occasionally the oldest passed me his wine bag. I handed them some cakes which they devoured.

First citizen

Finally my young host spoke. He told me that he lived here all the year round except during December and January when the snow was too deep and the cold too bitter. His task was to look after the mule herds and keep an eye on the *cortals.* Two or three months of this period he was almost always alone. I told him that he was the *batlle* or mayor. All three laughed.

Before departing I asked him for my bill. "Two dollars," said my host. I had told him that I was an American and he seemed to know that Americans used dollars. "But how much in *pesetas?*" I asked. "Two *pesetas,*" he replied. Encouraged by this favorable rate of exchange, two *pesetas* being twenty cents, I decided to take another plunge into the Llo Serrat money market, so I inquired the price in francs. "Two francs," was the snappy quotation, which was about eight cents. I struck an equitable balance. But I shuddered to think what might happen to some Englishman who might be charged in pounds and not have the happy thought of playing for a more favorable exchange.

Living in the long ago

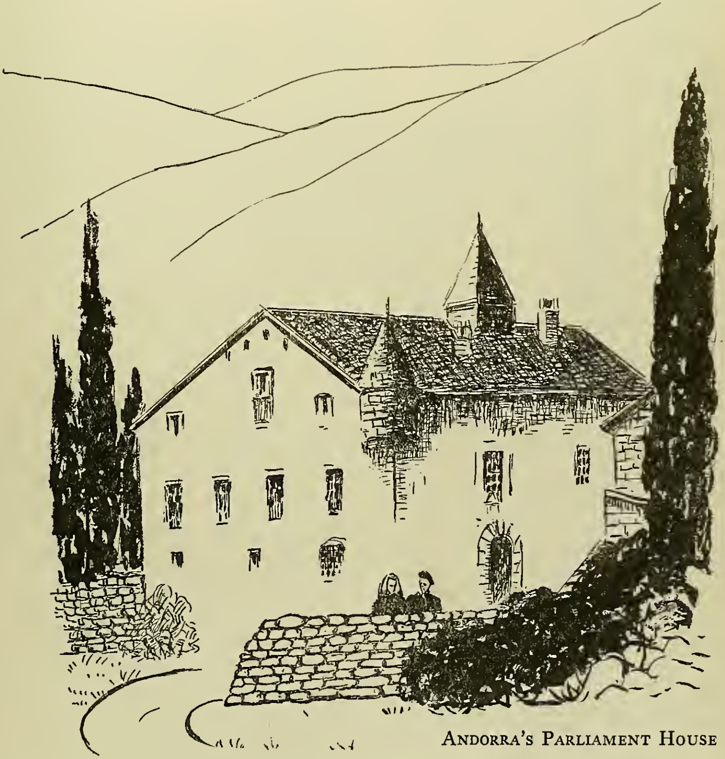
Andorra is the last of Europe's feudal states. It claims Charlemagne as its "Great Father" and the author of its liberties. While the rest of the world has been moving forward, it has been clinging to the ways of another age, so that entering there and beholding its strange customs is like making a journey into a tight little world of long ago.

Andorra is a land of sharp towering mountains, of high grazing plateaus, of deep green valleys, and of rugged gorges through which angry waters are forever pounding. It slopes down toward Spain into which it has a natural gateway near La Seo de Urgel. The country has two valleys, each traversed by a river: the Valira del Nord and the Valira del Orient. These valleys come together to form a Y, the stem of which is thereafter known as the Gran

Valira. Along these valleys lie villages and the six capitals of the six parishes, also called *communes.*

Andorra is called a republic and has a chief of state commonly referred to as the President, although his official title is "The Most Illustrious Syndic and Procurator General of the Valleys of Andorra." The real title of the state is the Valleys of Andorra. One of the co-princes to whom Andorrans do homage is nominally the President of France, although in reality the French Government has long ago, and with doubtful legal and moral propriety, taken over his functions, a fact much objected to by Andorrans. The other is a prelate of the Church, the Bishop of La Seo de Urgel, the only ecclesiastical authority outside the Vatican still exercising both a spiritual and temporal jurisdiction. For many centuries the Bishop of Urgel has resided in Andorra's "Spanish Capital," called La Seo for short.

The Most Illustrious First Syndic presides over the so-called Council General, a kind of legislative, administrative and judicial body rolled into one. It meets at four stated times of the year in the House of the Valleys at Andorra la Vella, and is composed of twenty-four councillors, four from each of the six parishes. Afoot or on mules, the councillors were wont to come in the days before the automobile and motor bus, the first councillor of each of the six communes bringing with him the key and the *llot*. The *llot* is cash representing each commune's share of the cost of properly enter-



Andorra's Parliament House

President's House, Andorra

taining councillors while in session. The six keys are for opening the great oaken chest that contains the national archives. Until all six councillors have come with their six keys the chest cannot be opened and the government cannot function.

The members wear long, flowing robes with curious flat, black hats having wide brims. There is an unwritten law that each councillor must come wearing a black tie. If he overlooks this formality he is admonished, and mayhap fined, by the Syndic, and sent out to get one.

The usages and customs require that the members of the council, once in session, shall not leave the capitol building until their business is concluded, and that their sessions be held in strict secrecy. Until the recent Youth's Revolution, the rule was observed and if there was likelihood that the sessions would last longer than a day, the men brought their blankets with them. There is in the House of the Valleys a great kitchen with a fireplace and spit in the center of the room suitable for the roasting of half an ox. Adjoining it is a dining salon, a rectangular piece down the center of which runs a wooden table flanked by benches. It is still the banquet hall for state occasions. There is also a chapel adjoining the session chamber, and there is a rule that each meeting of the Council must be inaugurated with the celebration of the mass. The six communes which the councillors represent are like six little countries in a world of their own. They have their quarrels and rivalries, their alliances and leagues, and it is even of record that once they went to war with each other, one and one-half of the communes remaining neutral.

Andorrans call themselves Catalans *de pur cep*—of pure vintage—by which it may be taken that they consider themselves free of Jewish, Moorish, and other infiltration to which Catalan blood of the lowlands has been subjected. No doubt they are a vintage of Frankish, Visigoth and other stock that preceded them. When the Moors began wiping out the Visigoths in the tenth century, it is of record that many of the latter retreated to the fastnesses of the Pyrenees and there successfully defied their persecutors. I have seen eleventh and twelfth century records bearing the names of families which still live in Andorra in the same localities.

During the centuries, I am told, the population never exceeded five thousand, though at least until recently, with the opportunities offered by the travelers, there has been a continuous exodus of youth seeking their fortunes elsewhere. By Andorran law they are forever Andorrans, as likewise are their wives and children no matter where born.

Andorra is the land of patriarchs. The head of the house, the *cap de casa,* is the guardian of the customs, the giver of laws, the wise man in times of danger, and, in his own humble way, a prophet. These men constitute Andorra's most distinctive institution.

Land a sacred possession

Land is the life of an Andorran, and is so limited that it has commonly been regarded as more valuable than gold or animals. Gold and animals may disappear but the land stands forever. To sell it is either a disgrace or a misfortune; and if for any reason an Andorran or his ancestor has ever had to part with it, it was given as a sort of pledge for debt with the right to redeem it even after a lapse of centuries. With the recent invasion of "civilizing" influences, however, the transfer of small parcels of land has become frequent.

It was out of the necessity for conserving the land that the family, which is the chief unit of the Andorran social group, derived its character. It is the rôle of the head of the house to transmit the centuries-old traditions of his house. The house is an immutable institution which preserves its name for all time, even though the family name change. The *cap de casa's* children, and their children, live under his rule so long as they remain on the land. The day will come when one of them will be his heir, inheriting the land, inheriting the rôle of upholding the family prestige, inheriting the title of chief. The heir is usually the eldest son but the *cap* may name another should he deem him more fit to carry on in the traditional manner.

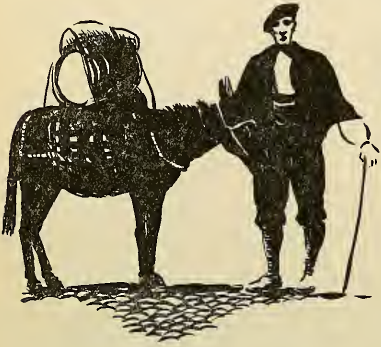
The Andorran heiress

It sometimes happens that the inheritance devolves upon a girl of the family. Such a one is known as a *pubilla,* and she is much sought after. It is almost a foregone conclusion that she will marry the heir of some other family. The heir, in that case, becomes the *cap* of the two houses, uniting them, but only for the time of the union. Both the *cap* and the *pubilla* will have their respective heirs after them, each heir becoming the *cap* of his own house, as of yore. If a *pubilla* marry a stranger, he becomes by that fact an Andorran.

Andorran houses, for the most part, are primitive affairs built of slabs of black slate laid one upon the other and ribbed and buttressed with timbers from the forests. They are topped with low-lying slate roofs, usually of the gable variety. Half-way across their façades are odd-looking balconies of roughly hewn wood. In many cases there is one such balcony at each upper story, beginning at alternate sides and ending in the center. Frequently iron grille work, reminiscent of the country's abandoned forges, replaces the wood.

That an advanced phase of building science was not unknown to the early Andorrans is proved by the arches of the bridges which with symmetrical backs humped over a stream, are to be found in all parts of the country. The same is true of the churches which are of an early romance style. Bridges and churches date from very long ago.

The interiors of Andorran houses are as quaint and cozy as they are primitive. Many of the smaller ones have only one story, in which case the fireplace is on the bare ground under a chimney. Furniture is scant but neatly arranged. One of the curious features in the great rooms which so often are kitchen, dining and sitting room, all in one, are the wooden racks for holding pewter spoons and forks. There are little slits in the rack, one for each piece. Over the fireplace are always two large pots. One is for the hot water, one for the family soup; and if there be a third it is usually for the cooking of feed for hogs.



Turnips are a staple article of diet for hogs but are considered unfit for humans. It was only after considerable urging that I could induce the family at whose *posada* one winter I was staying, to boil me some turnips, other vegetables being scant. They were good, but it nevertheless became a topic of conversation in the villages that I had strange tastes in the matter of food.

Soup of ham broth, hard black bread and potatoes constitute the Andorran's most regular diet. Other foods, such as mutton chops or codfish, esteemed a great delicacy, are fried over the coals or grilled on the spit. Sometimes this fare is varied by a civet or wild isard or broiled mountain trout. It is really astonishing what an elaborate meal the Andorran housewife can cook in this manner, once she sets herself about it.

Once when I was visiting the *cabana* of the Most Illustrious Syndic, the latter attended to the honors of making the soup. The soup is usually ham broth, and is rarely modified by vegetables or other meat. When it is ready, the soup is poured over hard black bread, cut up in a bowl. This forms the farmer's diet, morning, noon, and night, while he is up in the higher hamlets. His drink is black wine, savoring of leather, and squirted into the mouth from a wine bag. He almost never has tea or coffee, although if he has a cow or a goat, he may enjoy the luxury of milk. The Most Illustrious Syndic had two cows, Blanca and Negra, which did duty as oxen during the day, and which, the day's work done, he unyoked and milked.

Andorra is a land of four well-marked seasons. Spring comes almost imperceptibly in her rightful time, a shy soft lady emerging from her winter's mantle of ermine. She brings mountain flowers of glorious richness and color. Summer is a bright-eyed youth, clear of complexion and soft of breath, offering mild warmth, tarrying for a full measured season. Autumn is a gay, engaging urchin, coming in a time of fairs and dancing, not flying his colors too soon, lingering long. Winter follows, decking her mountains, her valleys, her forests, with mantles of snow. This, like the other seasons, is a time of beauty and delight. There are cold grey days, it is true, but there are long series of days when the sun shines brightly through blue cloudless skies, while encircling peaks protect the little valleys from wind, so that the air is warm during the hours of sunshine and one sometimes tramps out of doors in shirtsleeves.

At night the peasant lays himself down on the hay of the *bordes*. In even the largest of these mountain villages, containing perhaps a score of *bordes* with their *cabanas* there will not be found one solitary bed. Cozy places they are in which to sit on the little wooden benches by the fire with its cheering warmth, its odor of burning wood, while the pitch torch, stuck in a slab of slate that projects from the wall, burns and flickers casting odd shadows about.

Andorrans are of lithe and muscular build, like their donkeys. They have bronzed, regular features and bright eyes that are frequently greyish. Little remains of the quaint habiliment they once wore, their *barretina* of flowing and tasseled crimson, their tight pants and white leggings, their black sash, their coat of black velvet. Mostly Andorrans now wear home-made suits of corduroy, although frequently retaining the black cincture, which is wound round, and round, and round again, at the waist. Andorrans don't like suspenders, as to which they have invented a tongue-twister: *"Els elastics em fan fastics,"* meaning "Suspenders give me a pain." They have taken to the European, or American-style cap, wide, overhanging in front. In fair weather their feet are shod with shoes made of canvas, and of thin cord rope for the soles, these being easier for tramping over hard round cobbles, and seeming to lend to the wearers a certain nimbleness of hoof.

The women are slender, sinewy, bronzed, like their menfolk. And like the men they work in the fields or carry burdens along mountain trails. Picturesque, even pathetic, one thinks, these little women in black whom one sees at the labors described, or at such tasks as turning green hay in the fields with their wooden forks, herding a drove of cattle down from the mountains, driving a donkey along a high trail, themselves burdened with a load, like the donkeys. But always cheerful and ready to smile, never complaining. When they go to church on Sunday they vary their dress, always black, by the wearing of flowing black veils over their heads, giving them the appearance of nuns. Their daughters, however, affect raiment more vivid and gay. But the time will come for them to abandon their colors, to take their place with the women, carrying their burdens, doing their share of the family toil.

The women play an extremely minor rôle in the life of the family. Usually they eat in the kitchen after the men have taken their meals. On the other hand, even the humblest man-servant eats at the same table with the *cap*. I have not observed, however, that woman's minor rôle arises out of any pronounced notion of her inferiority. It is merely a scheme of things that seems to fit in naturally, biologically, and so is accepted without much thought on the matter. The attitude of the men toward the women is considerate. I have seen the men helping their women with household and kitchen duties, cutting the meat, drying the dishes, and even taking a hand at the cooking. It is essential for the men to know something about household duties, for they pass much time isolated in their mountain *cabanas*.

The Andorrans devote themselves to the raising of hay, grain, tobacco and stock. The tobacco is made into bad cigars and rasping cigarettes or rough pipe tobacco. The cigarettes are put up in fancy packages imitating the American brands, but that is the only thing fancy about them.

The mules, which graze in the high pastures, are sold every fall at the fairs of the villages to buyers from Spain, or are taken to other fairs across the Spanish border. They constitute an important source of income. Great rivers of sheep come up in the last days of each springtime to graze in the mountains, returning again in the chilling days of autumn. Mostly they come from Spain, but some flocks also cross over from France. They graze on the public lands for a consideration paid to the communes, this being an important source of public revenue in a land which traditionally has been without taxes. On the import side, Andorra buys much of its food, such as eggs, fresh meat, fresh and salt fish, including codfish, fruits, vegetables, olive oils, wine, as well as articles for household and field, from Spain, and, in lesser degree during the open season, from France.

Resources

Forests are one of its most important resources. The mountains are covered with fine pine. While there is an official conservation policy, in recent years quantities of timber have been cut down and sent out into Spain and one wonders whether the unwritten law of timber conservation is now not more honored in the breach than the observance.

The land has important iron deposits. Indeed iron mines were once scattered all over the country, and their products fashioned at crude forges. Geologists state that the region also has nickel, lead, copper and tin. Water, however, is Andorra's most important visible resource. It tumbles down in streams and cataracts on every hand, and has already been harnessed for the production of electric power in untold measure to provide added energy for the Catalan industrial centers.

Water plays an important rôle also in irrigation. It is caught up on every hand in canals called *reches,* which tap the streams in their upper courses and carry it sliding along high slopes and about mountain sides.

Only within the past few years has modern civilization begun to rap gently at Andorra's door. A highway, completed in the fall of 1932, has pierced its mountain barriers. It traverses the country from the French border to the Spanish. Traffic on it can be maintained during five or six months of the year depending on weather conditions.

This road is the way for civilizing influences and new longings are felt in the country of Andorra. There has recently been a revolution in which youth demanded the right to vote and hold office. Previously only the *caps* had this right. The *caps* opposed the demands of the youth, for it is their traditional rôle to guard the unwritten code of usages and customs, to see that they are transmitted from one generation to the next without change, and to see that they are observed by the public officers, by the Council General, and by the law courts. (Although the laws are unwritten there exist two manuscripts, résumés of the same, the *Politar* and the *Digest,* the former of which is the more generic and complete and is accepted as authoritative.) Reluctant to relinquish their special privileges, the *caps* have shown a disposition to renege on the concession wrung from them by force. So long have they been master that they are inclined to regard youth with contempt. But Andorran youth are determined and the victory would seem to be theirs.

An awakening country

A further result of contact with the outside world was an "invasion" of French gendarmes to assert French "authority." This the Andorrans resisted and continued to resist; there sprang up a nationalistic movement within the country which increasingly demands a complete severance of the ties which place Andorra under the tutelage of its co-princes, the President of France and the Bishop of La Seo de Urgel. And as this article is written the nationalistic party is preparing, in the face of opposition on the part of the co-princes, to present to a plebiscite of the people a new constitution which shall bring their unwritten code more in harmony with a modern day.

These are the political stirrings which civilization's belated arrival has caused in Andorra, and the present disturbances in Spain will doubtless further affect the little republic to some extent.

But although certain surface aspects of Andorran life have been affected the country has not really changed much underneath. Oxen plowing fields on mountain sides with wooden plows, tipped with a bit of steel; grain threshed by hand; the pitch torch and other primitive utilities and ways already described —these remain. Side by side with them are a few touches of modern progress, chiefly the automobile and electricity in the villages that are close to the new power lines. But the native largely sticks to his donkey. When the Andorran farmer goes plowing, he loads his plow on the back of his donkey and drives it up to the fields over laborious trails. And even over the new highway, in places where until a few years ago the natives had never seen an automobile, you will see donkeys or mules piled high with merchandise—with tables, bales or boxes of goods, a cart wheel, even a sheep or a hog slung across the saddle, or the ubiquitous sewing machine. This latter convenience is found in the most remote reaches of Europe, and one is tempted to say that it has gone just a little ahead of civilization. In Andorra the sewing machine is so generally of a well-known make that the housewife most commonly refers to it simply as her "Sink-err."

The high fields are patchwork of earth laboriously, patiently grubbed out from amid rock and brush, and sometimes slant so much that they seem ready to slide away into a ravine. The grain and hay is cut with old-fashion scythes and sickles. It is turned to the sun or loaded on the animals by means of wooden pitchforks cut out of the pronged limbs of trees. Flat wooden racks, provided with canvas flaps, are placed across the backs of donkeys and mules for the loading of hay and grain, and by means of them the animals can be weighted down with loads several times their weight.

I am not one of those who feel that Andorra will soon be spoiled by its highway. Andorra will always have its peaks and lakes and the trails that lead to them; its streams forever singing; its forest valleys with their streams tumbling down between craggy walls in turbulant pell-mell, laughing forever at man's efforts to tame them. The new road will attract a certain number of more venturesome European travelers who are lured from the beaten trails by the possibility of seeing one of the smallest countries in the world and one of the few niches where ways of the Middle Ages have lived into the present. But Andorra is not going to step into the twentieth century overnight.

See Martin Johnson's illustrated story of his recent expedition to Borneo in next month's *New* Natural History

INNUMERABLE CHURCHES *dot the rugged landscape of Andorra, which largely owe their support to the bequests of citizens who died centuries ago. Many of them are abandoned or are visited by the priest but once a year to comply with the age-old bequests*

AN ANDORRAN PEASANT TEAM. *There are eleventh and twelfth century records bearing the names of Andorran families still living in the same localities*

Andorra, a Country in the Past

All Photographs by Lawrence A. Fernsworth

Hiding back in the Pyrenees *between France and Spain among peaks towering to 9000 feet, Andorra has for centuries clung to the ways of long ago. It is one of the smallest countries in the world and is the last of Europe's feudal states. The President of the republic presides over a Council General, a combined legislative, administrative and judicial body, in the transactions of which quaint formalities are observed. Once in session, the members may not leave the capitol building, and until recently they brought their blankets with them. The meetings are held in strict secret, and the six communes which the councillors represent are like six little separate countries in a world of their own. The President, like the representatives, in private life pursues the simple pastoral activities of his ancient forefathers, owning two cows which are yoked like oxen during the day and milked at night.*

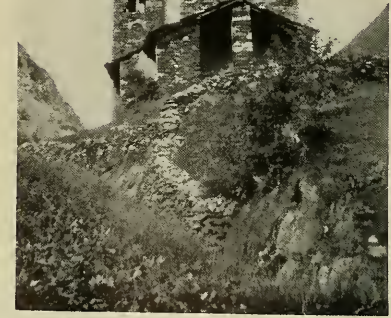
The Andorrans do homage nominally to the President of France, and to the Bishop of La Seo de Urgel in Spain, the only ecclesiastical authority outside the Vatican exercising both spiritual and temporal jurisdiction. Present disturbances in Spain will no doubt resound in Andorra, but it is hoped that this relic of the Middle Ages surviving in the modern world will long retain the charm of antiquity

The old hermitage *of San Antoni in the gorge of that name. Four years ago a motor highway pierced the mountain barriers of Andorra; but winter snows block it half the year, and many of the most charming spots are accessible only on foot*

(Above) TILLING THE ROUGH LAND *is a major activity. The Andorrans devote themselves to the raising of hay, grain, tobacco and stock. Irrigation plays an important rôle*

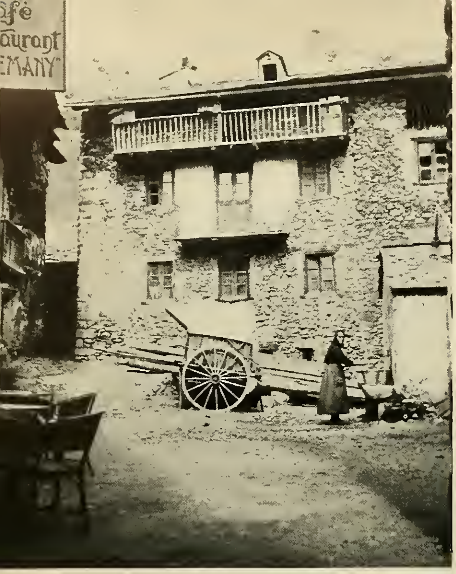
(Lower left) ONE OF ANDORRA'S *innumerable churches*

(Lower right) ONE WONDERS *if these children, unlike their parents, will grow up in a modern world*



(Above) GREAT RIVERS OF SHEEP *come up from France and Spain in the last days of springtime to graze in the mountains, providing an important source of public revenue*

(Below) THE SUMMER HOME OF THE PRESIDENT *of Andorra (in the foreground). The high mountain villages of which this one is typical are inhabited only in summer and early fall*



(Above) A CORNER IN AN ANDORRAN VILLAGE. *The houses are built of slabs of stone and frequently display odd-looking balconies of roughly hewn wood*

(Above) AN ANDORRAN PATRIARCH. *Deeply respected men of this class constitute Andorra's most distinctive institution*

(Below) ANCIENT STONE BRIDGES *are a common sight*

PICTURESQUE ARCHITECTURE *presents pleasing vistas against the rugged skyline*

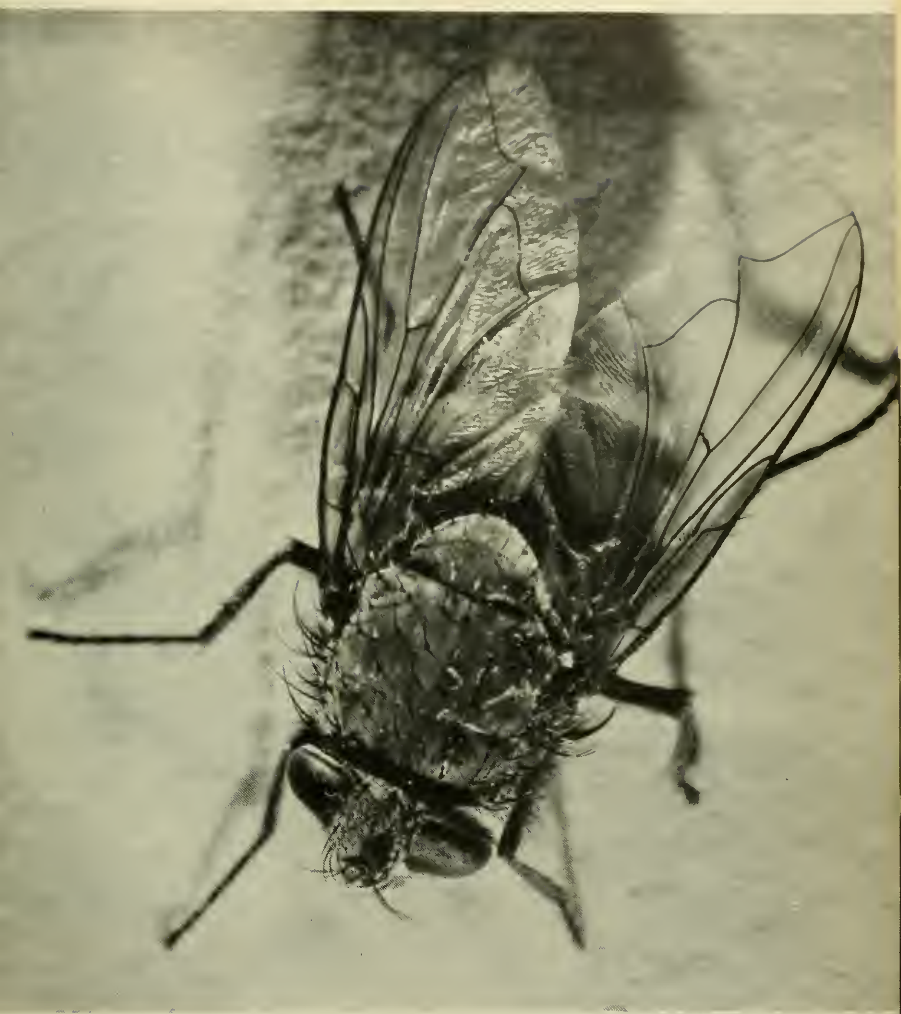
(Right) ANDORRA'S WHITE HOUSE: *The residence of the new President, Sr. Pere Torres. Strangely enough it is one of the few literally white houses in Andorra*

THE NEW MOTOR ROAD *and the gradual introduction of modern mechanical conveniences may mark a new day in Andorran history, but the country will always have its peaks, lakes, and mountain trails, and its picturesque historical background*

(Right and below) THE HERMIT OF MERITXELL, *Andorra's only remaining hermit. Andorrans are lithe and muscular, with bright eyes that are often greyish*

(Bottom center) A VILLAGE FAIR, *at which buyers from Spain are likely to purchase many Andorran mules*

(Below) FLOWING BLACK VEILS *are the Sunday fashion*



All photographs by Croy from Black Sta

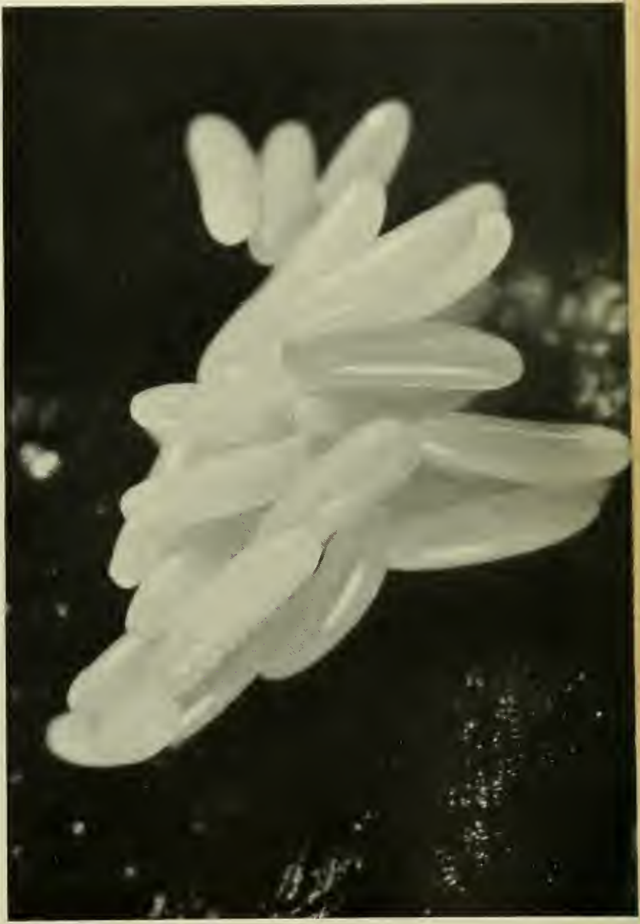
The Flesh Fly

THESE COSMOPOLITAN FLIES *are general scavengers and owe their name to the habit of depositing the larvae (or rarely eggs) on meat or on the wounds of living animals. In some parts of the world domestic animals and even man suffer greatly as a result of open wounds becoming infested with the larvae*

The life cycle of the insect, illustrated in the following pages, is very rapid during warm weather

WHEREVER MEAT LIES *for some time the flesh fly is liable to appear to deposit the larvae or eggs. Such forms as visit kitchens or camps may cause intestinal myasis in man as a result of eating cooked meat that has become infested*

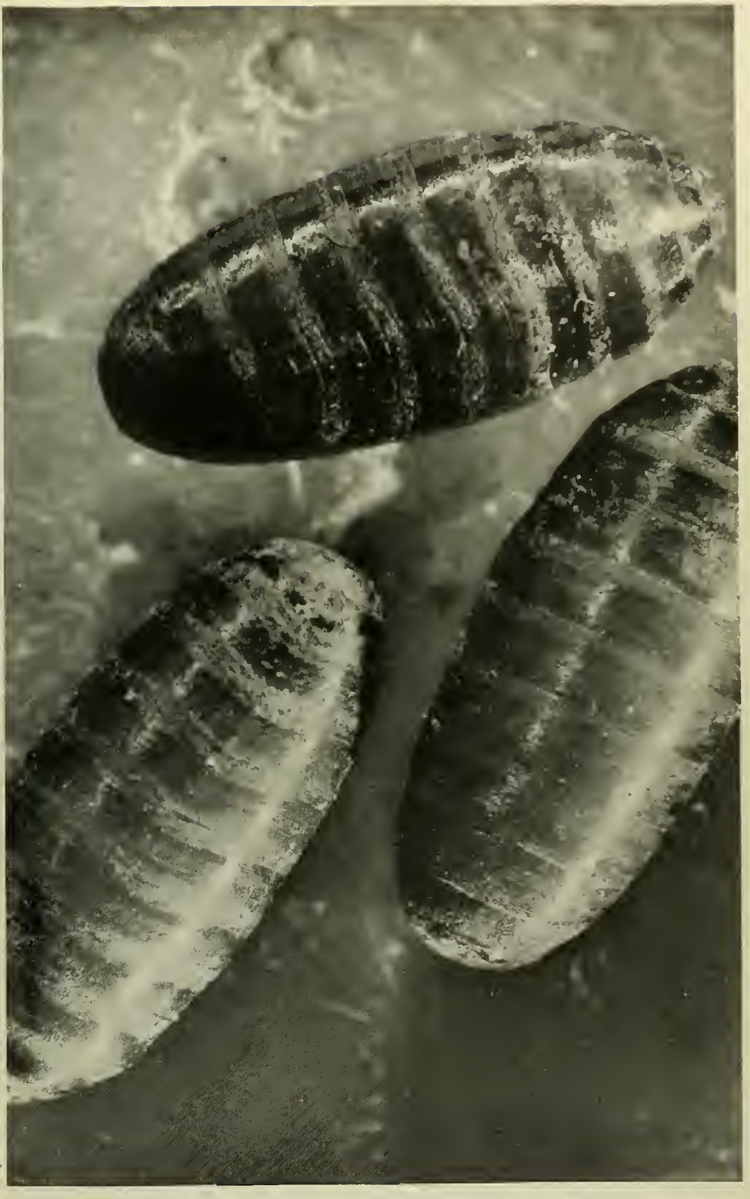
(Below) A SMALL HEAP OF EGGS, *enlarged about 35 times, which will hatch within a few hours. It is unusual for the flesh fly to lay eggs at all, for the latter usually hatch in the ovaries, causing living maggots to be deposited*



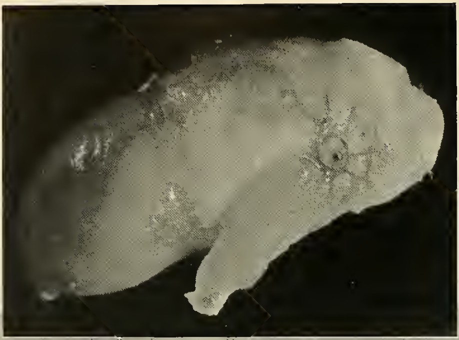
(Below) GROWTH IS RAPID *in the larval stage, which occupies from one week to one month. When full-grown the outer skin hardens and pupation takes place within*

(Above) THE SLENDER NEW-BORN MAGGOTS, *upon reaching the meat, usually bore within and begin feeding*

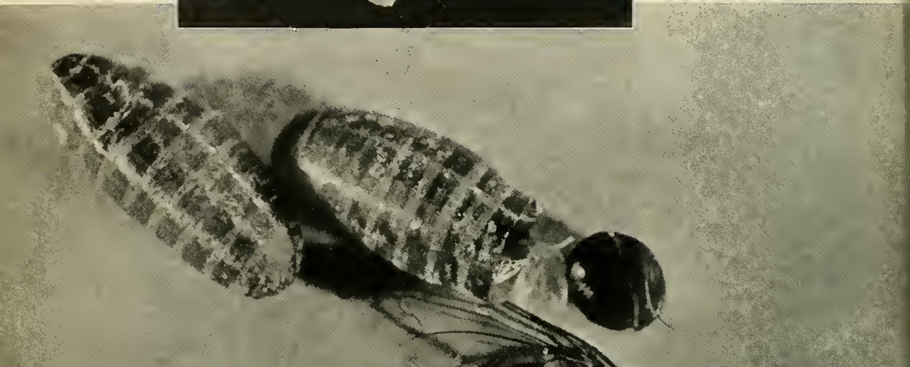
These maggots differ from the ones that are used beneficially in the treatment of infected wounds in that the latter do not attack living flesh. The fact that the flesh fly often deposits its larvae on fresh corpses before decomposition has set in has caused it to figure in medicolegal testimony



(Above) THE PUPAL STAGE. *Inside the puparium, transformation into the adult fly takes place. Usually the pupal stage lasts for from seven to eighteen days (in summer), but in temperate zones it continues through the winter*



(Left) THE PUPA *extracted from the puparium in an intermediate stage: the mysterious process of metamorphosis is going on within*



THE ADULT FLY EMERGES *two to five weeks after the eggs or larvae were deposited (except when the winter is passed in the pupal stage). In the above photograph the wings are not yet unfolded, but the transformation of the fly is complete. After the wings have hardened it will fly away and in several days will lay eggs or larvae, thus renewing the cycle*

The Penitentes

Without church sanction, a cult within our borders annually performs a grim ritual of self torture culminating in the crucifixion re-enacted

By FLORENCE MAY

"DOWN in the sand hills of New Mexico—" Those sand hills contain many more strange and wonderful things than the Indian maid who was glorified in the popular ballad of twenty years ago. Such things, for instance, as: the Carlsbad Caverns, the Frijoles cliff dwellings, and the Penitentes.

The Penitentes do not compare with the magnificence and beauty of the natural physical wonders of New Mexico, but this fantastic group of Mexican-Indians comprise a vital element of the peculiar charm that seems to rise from the very soil of this unusual state. The practices and ancestry of these natives go further back than any recorded history; so that they are one with the secret, brooding hills which they inhabit.

Origin

Self-flagellation is the creed and chief reason for existence of the order Los Hermanos Penitentes (The Penitent Brothers). Self-torture for expiation of sin was a barbaric practice in the early history of nearly every ancient civilization. To understand its presence in modern New Mexico requires some brief scanning of history and some logical conjecture on the gaps left by early records.

The first Spanish conquerors to reach northern New Mexico in the search for the Seven Cities of Cibola brought with them courageous priests of the Franciscan order. The followers of the Third Order of St. Francis were familiar with self-torture as practised by members of their order during its early years. Such barbarism had been suppressed by the church, but the pioneering priests were quick to recognize in the ceremonials of the aborigines a similarity to those of the Third Order. It was practical wisdom on their part to begin their efforts to civilize the Indians with symbols of Christ which compared with the stoicism of the savage tribes. The aboriginal mind was swift in grasping the drama and imagery of a crucified Christ. Though the Indians repeatedly accepted and rejected the patient friars through the violent conquests and rebellions of the pueblos, this impression persisted. Of the period between 1598, when Onate first established Spanish conquest of New Mexico, and 1794, when Father Bernal sent the first detailed report of the status of the church in New Mexico to the Governor of Old Mexico, the only remnants of the good Franciscan's efforts were the practices of the Third Order and the reenaction of the passion and death of Christ as perpetuated by the Penitent Brothers. After this time the order became gradually more secret, as its practices were more frowned upon by the church; and in 1886 this disapproval culminated in the issue of a diocesan order forbidding the celebration of mass in the Penitente chapels.

Prominent citizens

The fact that the church repudiated them did not particularly disturb the Penitentes. With increasing population of the state and consequent introduction of civilized law and order, they have drawn farther into the mountains and modified the rigid adherence to detail in reenactment of the grim passion play which characterized its early history. It is quite impossible to be certain of the exact number of American citizens who participate in the bloody rites each year. To be sure, it is known that as recent as 1890 certain men prominent in the political affairs of the state were sworn into the brotherhood.

The Brothers are found chiefly in small villages near Taos, Mora, and Abiquiu, and in Los Griegos near Albuquerque. The *morada* (council house) is, in fact, a chapel, and is the central building in these villages, though often in the more thickly populated districts it is well-disguised and hidden. Each group has an *hermano mayor* (elder brother) who is law-maker, judge, and high priest; an *infermo,* who attends the sick; a *resador,* who recites the prayers; and a *cantador,* who sings the ancient chants written in sixteenth century Spanish.

Cactus whipping

The annual ceremonies which comprise practically the only activity of the order take place from the first Friday of Lent to Easter morning. All members do not participate in the formal ceremonies every year as there is a rotary system whereby each has his turn every three or four years. Each Friday night throughout Lent the eerie sound of the *pito* (primitive reed flute), with its Oriental grouping of notes and its Gregorian idea of tune, leads the *flagellantes* up the Rastro de la Sangre (Path of Blood) to El Calvario, a hill of rotting crosses of previous years. The participants wear only a breech cloth of white cotton and a crude head mask which serves the dual purpose of increasing humility and preventing recognition. The penitents flog themselves pitilessly with the *disciplina,* a whip made of thongs of yucca cactus leaves from which the fibrous matter has been stripped.

Along the weary trail of punishment the queer rhythmic drag and shuffle of feet, accentuated by the sickening sound of the vicious whip as it is swung first over one shoulder and then over the other, fills the mountain stillness with chilling tensity. If there is a break in the perfect precision, the brother who has fainted is assisted by the *hermanos de luz* (brothers of light) whose duty it is to sustain the self-torturers. If, however, he merely falters he is flogged by the *sangrador* who walks beside the procession lending the urgency of vigilance to the fervor of the penitents.

As Easter week draws near, the number of participants in the formal processions increases, and other ingenious forms of self-inflicted penance are performed by the entire community. Severe fasting is universal throughout Lent but in this final week it becomes more stringent. Such ghastly practices as dancing or crawling on cactus beds, hugging the *cholla* (barrel cactus), and carrying huge, rough-hewn crosses are common in these last days when the exaltation of atonement is at fever height.

The Holy Week of Christianity is celebrated by the Penitent Brothers with savage ceremonies which climax the horrible Lenten activities. Holy Tuesday services consist in the renewal of faith in which the members receive the "seal of obligation" of the order—three gashes down and across on the back, by a crude knife of broken glass or rock set just deep enough in its wooden handle so that it will not sever the muscles of the back. The more devout and sturdy members request additional gashes for the three meditations, the five wounds, the seven last words, and the forty days.

Ash Wednesday and Holy Thursday are spent in singing and praying by processions of scourged penitents who repeatedly make the way of the cross to the *campo santo* (burial ground) and *calvario* on knees or bleeding bare feet; always accompanied by the spine-tingling flute and the weird rattle of the *metraca* (a wooden noise-maker, "thunder-twirler").

The Cross

The crucifixion, which is the high point of all the frenzied ceremony that has gone before, takes place Holy Thursday at midnight. The chosen *Cristo* drags his heavy wooden cross to the spot, absolutely secret, where the drama is to take place. Where in years past the one so honored was realistically pinned to the cross with nails through the full three hours, he is now bound by rope or leather and remains hanging only forty-five minutes, as it has been found that the circulation completely stops after this time. The favored individual is swathed in white from head to foot to prevent recognition, and if he dies (which is rare unless he has been terribly weakened by fasting and loss of blood in the Lenten scourging) his burial is secret and even his family is not aware of it until his clothing is returned to them. This final atrocity ended, the members accompany the crucified one along the road back to the *morada*. If he is able he carries his cross back with him, or is aided in doing so by the brothers of light, and it is placed among the others on El Calvario. At the *morada* the long fasting is broken with rough plain food and the members rest their weary broken bodies while the *infermo* attends the more desperately wounded. Some of the hardier members continue through Friday or Saturday with the solemn and involved *tinieblas,* a ceremony which seems to commemorate the three hours of Jerusalem, though its inception is so blurred that the brothers themselves are not quite clear on the subject. Here there is no glory, no happiness as in the orthodox Eastertide. True, some of the communities celebrate Easter Sunday in a manner somewhat approximate to their simpler neighbors. Their children often receive communion in white dresses and carry candles in attractive Easter processions, but the dark undercurrent of deadly seriousness invades even the innocence of the children.

Death penalty

There is little to add: the Penitente is a quiet law-abiding citizen throughout most of the year with no more important vices than his neighbors. The laws of the order are very stringent as regards their conduct toward each other. An offense against an outsider is not noticed or punished, but the slightest breech of form in the relations between members of the order brings swift and severe justice. The endurance of the men being so well known there are few possible punishments besides death, and this is decided upon usually for almost any crime from corn stealing to horse or wife thievery. Honor among thieves? Perhaps, but it is a code, and one difficult for anyone to understand who has not observed the natives of this district at length.

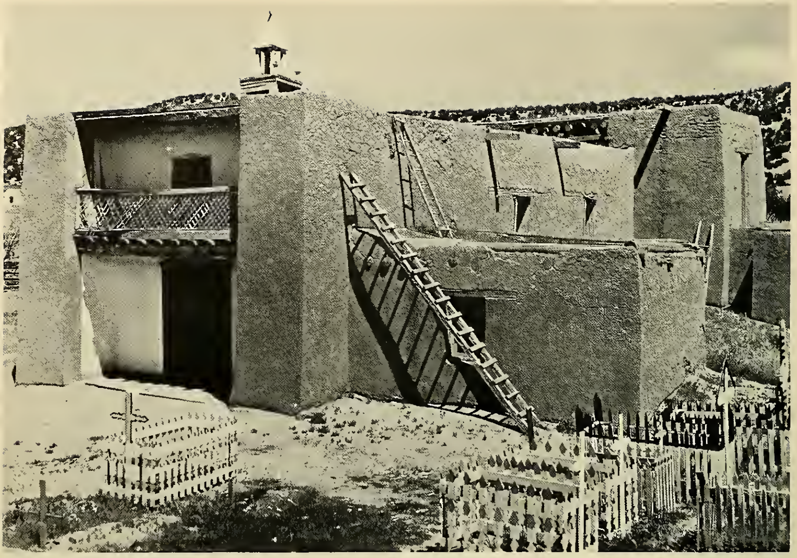
The reality of the yearly Penitente ceremonial is attested to by any number of reliable residents of the state who have witnessed some of the rites, whether by accident or carefully planned design. It is not advisable, however, for strangers to go sight-seeing in Penitente territory during Lent. A pain-crazed man in the throes of fanatic ecstasy is not a reasonable human being. There are vague, unconfirmed tales of strangers who never returned from such visits. It is hard for those who have lived among the simple natives of New Mexico for any length of time to believe them capable of molesting anyone.

Sacred to the Indian

The Indian of any tribe is a strong believer in minding his own business. He respects the silence and the personal idiosyncrasies of his neighbor and he rightly expects like consideration. The fact that the ceremonies of the Penitentes seem savage and revolting to the civilized mind, does not alter the fact that these rites are intimate and sacred to them. If common decency will not restrain the morbidly curious, they should be warned that the stolid, stupid-appearing Indian has the "sixth sense" of many wild things and instantly detects curiosity as differentiated from sympathetic interest.

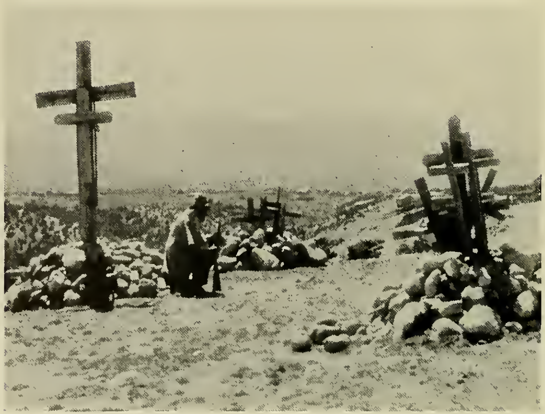
The stranger is welcome in New Mexico and there is much that is beautiful, much that is interesting for him to see. There is an individual charm—not confined to simple external things like scenery or wide open spaces—a feeling, dramatic, strong, big, that comes from the earth. To the outsider such a statement may sound absurd, but possibly this short explanation of the Penitentes may give that outsider an idea of its meaning.

Perhaps someday you who read this may see the snowy tips of the Sangre de Cristo mountains stained red with the startling reflection which is a sunset phenomenon possible only in the rarefied atmosphere peculiar to northern New Mexico. If such be your good fortune, you will understand why the conquistadores called them "mountains of the blood of Christ." If you remember then that clustered against these mountains, high on their plateaus and deep in their recesses, dwell the Penitent Brothers—it may give your appreciation of beauty an added touch of interest and significance.



AN ANCIENT MEETING PLACE OF THE PENITENTES: *adjoining the adobe walls of this century old church at Trampas, New Mexico, is the* morada *(meeting place) of a cult that has, for generations, practised a barbaric travesty of the Lenten rites*

PENITENTE CRUCIFIXION GROUND: *from the* morada *the Brothers tread the "Path of Blood" to this hilltop. Here the ritual is climaxed by a symbolic re-enactment of the crucifixion*



★

THE INDOOR EXPLORER

By D. R. BARTON

MUSEUM IN SUITCASES: It is a little disconcerting when you are looking for a staff official of the American Museum's Education Department, under the directorship of Dr. George H. Sherwood, to land smack in the middle of a baggage room.

Surely there had been some mistake. A baggage room is all very well in its place—Grand Central terminal for instance. But somehow one just doesn't belong in the Education Department. And this was a baggage room all right. There were rows of steel racks divided up into shelves that contained suitcases; literally hundreds of them. Maybe it wasn't a mistake after all, but simply a practical joke some overgrown prankster was having on this callow columnist.

Ah well, an apologetic inquiry or two would set us aright. We buttonholed a passerby. This was, of course, not Mr. Herman A. Sievers' office.

Oh, but it was.

Mr. Sievers of the Department of Education?

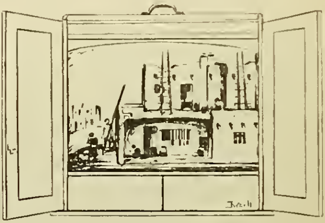
The same.

But all these suitcases, surely now—

"These aren't suitcases, they're exhibits." Our eyes narrowed. This was going too far. "Exhibits, eh," we exploded. "Now look here—" "Very well, if you don't believe me, there's Mr. Sievers, ask him."

Somewhat reluctantly, we accepted Mr. Sievers' invitation to sit down facing a very realistic and very angry-looking bison's head. First of all, we said, we wanted this suitcase business cleared up. Mr. Sievers whisked one at random off its shelf, and slipped open its catches. "Oh they really are exhibits," he said deftly plugging a wire into an electric outlet. When the lid was flipped down his interviewer found himself staring incredulously at a brilliantly lighted Hopi Indian village in miniature, complete with adobe walls, ladders and the braves with their squaws engaged in the daily routine.

It developed that Mr. Sievers had about 3000 such exhibits stowed away in suitcases. "Everything," he said, "that you see in the Museum proper, we have here in miniature."



The "suitcases" are loaned on request to public, parochial and private educational institutions all over the city of New York for periods of one week. "Of course, we have motion pictures and stereopticon slides as well," said Mr. Sievers, "but teachers are generally agreed that these object exhibits are by far the most effective medium. The trucks deliver five days a week—" "Trucks?" "Yes, we have six of them."

It seemed there was an average delivery of 180 to 210 exhibits per day with many requests left unfilled. "See that map over there?" Mr. Sievers' arm swept toward the opposite wall.

"Asia?" we ventured.

"Brooklyn."

The dark ridges we had taken for mountain ranges turned out to be clusters of thumb tacks indicating the location of schools in that borough alone that were "educating by suitcase."

There is an exhibit for every purpose too. Wide-eyed Kindergarteners squabble for places near a "suitcase" showing the developing stages of a butterfly; while, in the halls of higher learning, austere students of comparative anatomy take notes on lectures illustrated by the same method. A Neapolitan immigrant makes rapid strides at night school with the aid of the miniature exhibits, and instructors of backward children have obtained striking results through this medium.

Mr. Sievers lighted up another exhibit showing an otter in its natural habitat. "Not long ago," he said, "they brought some blind children in here. I took a lot of animals out of their cases and spread them out on that table. It was fascinating the way they walked around feeling the fur and calling to each other, 'Have you *seen* this one, isn't his fur nice?' Their touch was so sensitive they could almost distinguish colors."

Was the taking of animals out of their cases an exception, only for blind children?

"Not at all. That's one of the advantages of the method. Teachers let them take the specimens out and examine them at will."

Wasn't there considerable loss and damage?

"Not any more. Back in the early days we used to have some trouble that way, but now we get fine cooperation from the teachers."

"How long—" we started.

"—Have we been doing this?" smiled Mr. Sievers, "well that's rather a leading question, but I don't mind telling you that about thirty years ago I was driving a horse and wagon loaded with nature cases. When the horse gave out we switched to an electric truck which habitually came to grief on Brooklyn Bridge. Later on, I made the rounds in a shiny black Ford and was constantly being taken for a physician."

Today the Education Department distributes the Museum in suitcase form to about twenty-seven million scholars, young and old.

The 3000 miniature exhibits facilitate the teaching of biology, all branches of nature study, and astronomy. They make studying geography and history an entertainment rather than a task, and they are of matchless value to students of drawing and design. In almost every field of pedagogy the visual exhibit is replacing the well-thumbed text book and the dreaded birch rod. Educators the world over beat a path (through the "baggage room") to Mr. Sievers' door, the Japanese school system, which is being built up faster than you can say "Manchukuo," having already dispatched two of its emissaries to study Mr. Sievers' methods.

After peering at a bird group that had been retired from active service, we got to wondering about wear and tear on specimens. "Now, there's a funny thing," Mr. Sievers said in response to our query. "We get splendid reciprocity from the schools. The children pick up birds that have fallen during migratory periods, bring them to school and the teachers ship them right off to us to be mounted. Then too, you'd be surprised at the number of sailors who spend their shore leaves up here. And they give us specimens—lots of them."

We were pleased to hear that at least some of the controversial legislation that is current, operates to Mr. Sievers' benefit. We learned that a section of the customs law provides that no animal or bird of foreign origin can pass inspection unless it is directed to a scientific institution. "That means that every time a specimen gift is seized by the customs office the addressees would sooner turn it over to us, than have it destroyed on the spot," our host pointed out. "As to the geography exhibits, like this one," and an illuminated portrayal of tea, from blossom to cup, appeared before our eyes, "commercial firms have been very good about paying the expense of the construction. They write it off as advertising. We get exhibits of almost everything from the manufacture of buttons to the producing of oil that way.

"Advertisers use our exhibits too, you know. Many of these animal series you've been seeing in the newspapers lately were photographed up here."

Commercial photographers and artists, we were told, often set the department buzzing like an apiary. Once an interior decorator, avid for ideas on a Park Avenue bathroom, ransacked the store-room and came up with a seaweed specimen that looked like fine dried pine needles. It was her choice as a prevailing motif.

Another time, a pair of perspiring detective story illustrators pleaded for a shrunken human head, and, after considerable browsing about, made off in triumph with the stuffed head of a small monkey.

Someone recently phoned Mr. Sievers and declared he was calling for Fannie Brice. Mr. Sievers has a turn for humor so he demanded, "Who may that be?"

"Haven't you ever heard of Fannie Brice, the comedienne?" came in shocked tones from the other end.

"Well to make a long story short," said our host, "Miss Brice wanted to pose for a photograph with a bird. So I told her to come up here and pick one out. That's the one she chose, that little rose-breasted cockatoo over there."

As he was speaking, Mr. Sievers reached into a cabinet, withdrew a fair-sized doll dressed in colorful Italian costume and began to fondle it. His interviewer must have looked somewhat apprehensive, for he hastily explained that his 290 dolls were not for his personal recreation but were also distributed to the schools. "Teachers are exploiting the children's natural liking for dolls in familiarizing them with the costumes worn in different parts of the world," he said. "Now here is a Chinese lady—and this one is an Eskimo hunter—it's all part of the visual education program."

As we were ushered out on our leave-taking, we looked at the baggage room with a new interest and reflected that if education was indeed the keystone of democracy—we had this day met a champion of that institution.

Bats, but no belfry: When we were a little boy we got badly bitten by the mystery story germ. The thing we remember best about that period of maladjustment was a feverish thirst after bats. We doted on them. It got so that we chucked a story right out of our sick bed if the author didn't fill up his locale with a lot of bats in chapter one. That explains why so many childhood memories flooded in upon us, when we stumbled on the Philippine Island Bat exhibit while ambling along the third floor of our Museum.

But before we had time even to dry a reminiscent tear, we were struck with an awful truth. We had utterly neglected the beguilers of our infancy. We didn't know anything about bats any more. Of course, we had grown up with some vague notion that bats were creatures invented long ago by a mystery writers' guild, and that the craft of using them for props had been handed down from mystery writers to their eldest sons from time immemorial. We didn't, you understand, believe this in our heart of hearts; but, tainted by our early affliction, we could have explained bats in no other way had you put us to it.

So we scuttled out of sight before someone asked us, and went in search of more tenable information. After badgering nearly everybody who pretended to a knowledge of them we gleaned that there are about 2,000 different species and sub-species of bats; that the ones who had evoked our tender remembrances, the Philippine Island Fruit Bats, had too remote a habitat to have influenced the authorship of the nineteenth century tales of terror, and, lastly, that the bats that did gain literary fame were helpful little fellows that devoured annoying insects, whereas these winged dwellers of the Philippines were the bane of fruit growers in that region.

The fruit bat, which keeps pretty much to the southern hemisphere, is so called because he eats fruit. Like all bats he is a mammal and sleeps in the daytime upside down. A night feeder, he wakes up at twilight, rights himself, and strikes out in droves sometimes a thousand strong for the plantations. Arriving at a clump of bananas, he carefully selects his evening meal, plucks it, and wings his way back to the tree-top roost. There, he removes the outer skin with a nicety born of long practice, and gormandizes happily at the expense of his unwilling caterers. His menu includes the sweetish, the acidulated and the juicy, thus coinciding with the human taste for fruit.

Since he can gobble up several times his own weight in fruit without recourse to an alkalizer—(and he is lots bigger than his insectivorous cousins)—fruit growers in many localities have to swathe their trees with reams of protective netting. He is a selective gourmand. Don't get the idea that he stuffs a dozen bananas down his narrow oesophagus at one sitting (or in his case, hanging). He simply extracts the essential juicy matter, and doesn't bother to clean up afterwards. That's why they find big patches of fresh pulp underneath the dining trees.

There is one compensation for his voracity. Not over-careful about crumbs, he drops many seeds which serve to propagate wild fruits beyond the confines of the plantations.

He isn't a past master of aviation like his northern relative, his wings being devices to carry him from tree to tree. If unmolested, he will often eat the fruit on the spot.

One reason why mystery writers have passed up this particular species, is his looks. The northern denizen of creepy, old buildings and belfries has a rather blood-chilling face which has always been the fortune and delight of the manufacturers of scary entertainment. Our fruit bat is pleasant and sleek, his head looking rather like that of a small fox, and he insists on trees, not mouldering manor houses, for his home.

Among other things, we learned that bats are the only mammals that can really fly, that they have been flying a couple of million years longer than man has graced the globe, that only a few of them can do better than stumble about on wrists and hind feet when walking, but that, oddly enough, most of them are good swimmers, able to make creditable headway in calm water.

THE COVER THIS MONTH

This design is taken from a larger and finely preserved specimen of the feather cape made by the natives of Hawaii and worn by their kings and nobility in war. The cape illustrated was brought to this country by Captain William Cunningham of Cambridge, Mass., who died in the early part of the 19th century. After being kept in a chest for eighty years it came into the possession of Mrs. L. P. M. Curran of Englewood, N. J., from whom Mr. George S. Bowdoin purchased the cape in 1908 and presented it to the Museum.

Because of the intricacies of manufacture and the difficulties of securing the tremendous amount of feathers required, a century sometimes elapsed before one of these garments was completed.

These feather capes of Hawaii were made on a foundation of carefully prepared netted twine by means of a series of modified square knots, which left meshes of from one-sixteenth to one-quarter of an inch in size. Strips of the netting measuring from eight to eighteen inches in width are pasted together, conforming the cape to the size and shape desired.

The feathers were secured from several species of birds, the natives appointing men whose especial duty it was to snare the birds and obtain the necessary feathers.

The final step in the creation of the cape involved attaching the feathers to the twine net by supplementary threads with a series of half-hitches about the quills which were then bent over and tied again for greater security.

The Master Key to Oil

(Continued from page 373)

genera will be fully covered. To provide maximum ease in using such a compilation, the generic units are to be arranged alphabetically, and within each genus, the species are also arranged in the same manner. Since there are more than 12,000 species and approximately 1100 genera, the completed compilation will consist of twenty-five volumes of 1000 pages each. Here, then, will be gathered the vital portions of the world's literature on this group—a veritable storehouse of information the like of which has never before been seen. And huge as it is, it is linked to a still greater source of materials, the bound photostat copies of every article and paper that has ever been written on Foraminifera. This great library is to be housed in a central clearing-house, and each species and genus in the published compilation will be linked to it through the subsequent references. This phase of the undertaking is, of course, a permanent one, since it will not only constitute a link with past literature, but will also serve to keep the published compilation up to date by adding new materials from current works.

Recruited as it has been from the ranks of the unemployed, the staff carrying on this work is as amazing as the undertaking itself. Artists, typists, paleontologists, geologists, biologists, translators, editors and proofreaders as well as many other professions and crafts are represented. Practically all have at least one university degree, and many have two or more. In age, they range all the way from youngsters just out of college to retired university professors in their seventies. Work can be carried on in more than a score of languages by this group, and for almost every problem that arises, one or more specialists are available to solve it. Small wonder, then, that this organization has won the admiration and respect of every scientist and engineer who has had the opportunity to see it in operation.

What such an enterprise will mean to the petroleum geologist is quite evident. He will still have his problems of buried structure and difficult correlations, but both will have lost most of their former terrors. At last he will be beautifully equipped to read the riddles of hidden treasure and turn them from barriers to sign-posts. Foraminifera are indeed the "Master key," the "X-Ray eyes," so long sought for. Soon, too, the petroleum geologist can marshal a mighty staff of experts to aid him in his work. Hosts of scientists, long since dead, will stand at his side, their wisdom and experience at his command. No longer will he have to flounder hopelessly through mountains of jumbled literature nor be shackled by imperfect, unreliable information. And as the new source books on his desk will link him with these workers of a bygone age, so, also, will the proposed clearing-house for literature and specimens bind him to every living worker in this field. With the savants of micropaleontology as his staff and the world as his laboratory, he can face the future with a much greater measure of assurance and certainty.

Your New Books

Out of Africa—Audubon—Jabo Proverbs—March of Science—Naturalist in Ethiopia

OUT OF AFRICA

by F. G. Carnochan and H. C. Adamson

Dodge Company, $2.75

OUT OF AFRICA, by F. G. Carnochan and H. C. Adamson, gives, as stated in the authors' Foreword, "a picture of a vanished Africa as seen with a black man's eyes." The black man is Kalola, of the Wanyamwesi Tribe of Tanganyika Territory, who lived from 1856 to 1933. These years were tragic ones from the black man's point of view, for during that time white men took possession of the continent.

Kalola was one of the last great Medicine Men. There are Medicine Men in Africa today, but their influence is only a shadow of that wielded by their predecessors. Their power in the old days was almost unlimited, for no tribal Chief acted without consulting them. Their art was a strange blend of blind superstition, surprisingly accurate scientific information and hard common sense.

The Wanyamwesi Medicine Men belonged to a secret Guild, known as the Empire of the Snakes. Kalola inherited the leadership of this Guild. The first thirty years of his life were consequently full of color and action. His childhood was devoted to preparation for his position in the Guild. As a youth he went as rifleman on an Arab slave safari. With the safari at Ujiji, Kalola saw his first two white men, and heard his first English speech. The speech was Stanley's: "Dr. Livingstone, I presume?"

At twenty-five, as head of the Snake Guild, Kalola became confidential adviser to the great Wanyamwesi Chief, Mirambo. Mirambo has been called the black Genghis Khan. By conquest and absorption of weaker tribes, he came nearer than any other Chief ever did to creating a powerful and integrated black nation in Central Africa.

His years as power behind Mirambo's throne marked the peak of Kalola's career. The latter part of his life was a twilight, during which he witnessed the complete subjugation of his people by the white race. He himself spent these years in hiding from the new authorities, who set out methodically to break the power of the Medicine Men.

F. G. Carnochan, whose ethnological researches have taken him on three African expeditions, became friends with Kalola during the latter's exile. *Out of Africa* is based on information obtained by Mr. Carnochan in their many conversations.

If Kalola's last years were sad and bewildered ones, at least he found time to leave a fascinating record behind him. While the skeleton of the book is the story of his life, about Kalola's figure is hung the rich lore of a whole tribe, with their strange rites and ceremonies, their ancient customs, traditions and beliefs. There are a few spots where the reading is not pleasant; but one could not be squeamish and write with any truth of a people who openly and happily reverenced sex, whose ideas of justice were simple and direct, and whose gods required constant propitiation, which sometimes took the form of human sacrifice.

Messrs. Carnochan and Adamson have handled their subject with the sincerity and frankness which it deserves. A schedule of dates and an appendix give valuable supplementary information. The whole is a convincing account of "a vanished Africa."

LUCY POPE CULLEN.

AUDUBON

- - - - - - - - - - by Constance Rourke

Harcourt, Brace & Co., $3.00

THIS is a very readable volume. Its author has evidently been a diligent and sympathetic student of the abundant autobiographic material bearing on her subject and has thoroughly prepared herself to produce a narrative history of Audubon's life. She seems to have acquired an understanding of Audubon's character and temperament and presents, therefore, a picture of Audubon the man. She writes with apparent authority of Audubon the artist. She appears to be familiar with the America of Audubon's day and writes with ease of the Mississippi valley region in which so much of Audubon's work was accomplished, though we are surprised to find her speaking of modern horses as though they existed in this country prior to the discovery.

We are told of Audubon's childhood in France, of his young manhood at Millgrove near Philadelphia, of his marriage and life as merchant and mill owner in Kentucky, of his travels and explorations in search of material for the still unequaled undertaking he began without a penny in his pocket, of his amazing achievements as artist, author and publisher; but of Audubon the ornithologist we find comparatively little. After all Audubon was an ornithologist and the results of his labors, whether recorded with pen or brush, were designed to be contributions to our knowledge of the habits and appearance of birds. The bird-student asks, therefore, what is the value of these contributions to bird biography? How did Audubon acquire his knowledge of birds? What did he know of birds when in 1820 he definitely committed himself to his life-work? How does Audubon's work as a painter of birds compare with that of his successors?

But we look in vain for replies to these and similar questions. Our biographer repeats without comment Audubon's erroneous belief that the colors of birds' feathers fade soon after death. She writes of Audubon's skill in artistic composition, but says nothing of the degree of success he achieved in presenting the form, pose and personality of his subjects. She includes among the dozen Audubon plates selected for reproduction several which show the artist at his worst. That of the blue-winged teal, for example, was apparently drawn from wired birds in which the wings and feet were improperly posed and the male of the pair placed in the lead.

Evidently, therefore, the ornithologist should collaborate with poet and historian if we are to have a well-rounded life of Audubon.

F. M. C.

SCIENTIFIC PROGRESS

by Sir James Jeans, Sir William Bragg, E. V. Appleton, Edward Mellanby, J. B. S. Haldane, and Julain Huxley

The Macmillan Company, $2.00

IN reviewing the six papers which formed the Sir Halley Stewart Lecture for 1935, it is hardly possible in this brief space to do more than to recommend them immediately and heartily to the reader's attention. Here are outstanding leaders in their various fields—each one attempting to bring within the narrow scope of an hour's lecture the really significant advances in his own science up to the present time—each one attempting to put his finger directly upon the crucial and engrossing problems with which he and his colleagues are dealing. For the general reader interested in a survey of the most important thinking of the day in these fields, this symposium may be most highly recommended.

In each of these six papers the most interesting and important highlights of the past have been touched upon, those highlights which must become familiar to the reader if he is to understand the evolution and meaning of present-day conceptions.

Sir James Jeans writes of *Man and the Universe,* reviewing the important advances in man's cosmological ideas, from the conceptions of the ancients down through Copernicus, Galileo, Newton and Darwin, ending inevitably with Einstein, de Sitter and Eddington. In the last analysis, Sir James sends us for our *true* picture of the universe to the mathematician, to whom we must go "if we want the ultimate truth about the universe or its constituents." Sir James' whole paper argues also against the conclusion that our present-day astronomical knowledge need lead us to a purely mechanistic conception of the universe.

The second paper, by Sir William Bragg, treats of *The Progress of Physical Science,* and here we find the latest news about the atom family, chronicling the activities of electron and proton, and leading specifically, as an example, with the protein molecule.

Professor E. V. Appleton, in *Electricity in the Atmosphere,* deals with the unsolved problems of atmospheric electricity, particularly speaking of such things as electricity in the lower and in the higher atmospheres, abnormal radio transmission, and the solar cycle.

The fourth paper, *Progress in Medical Science,* by Dr. Edward Mellanby, gives an "outline of progress made in medicine and medical science through the centuries." In speaking of the present-day aspects of medical progress, Dr. Mellanby, treats, among other things, of the suppression of epidemics, the use of serums, and the great advances in nutritional knowledge.

In Chapter V, *Human Genetics and Human Ideals,* Professor J. B. S. Haldane examines the two interesting theories that "racial health necessitates the sterilization of the unfit," and "that some races are superior to others whose members are incapable of rising to the highest levels possible to humanity."

In the last chapter, on *Science and Its Relation to Social Needs,* Professor Julian Huxley presents a real indictment of our present so-called civilization. Professor Huxley examines the fields in which we have actually been able to apply our scientific knowledge. And then he continues to show the many more important ways in which we are prohibited from applying the knowledge of the scientist because of our economic and social systems, in which the profit motive is the dominant one.

These papers make stimulating reading, leaving one a bit breathless at the long vistas presented, both past and future. They also impress upon the reader inescapably the fact that science may become in the future the true saviour of mankind, although at the present time, because of man's greed and blindness, science has not yet achieved that highest eminence which is its heritage.

MARIAN LOCKWOOD.

ARTIST AND NATURALIST IN ETHIOPIA

- - - - - - by Louis Agassiz Fuertes and Wilfred Hudson Osgood

Doubleday, Doran & Co., Inc., $5.00

IN September, 1926, Louis Agassiz Fuertes accompanied a Field Museum expedition to Ethiopia as ornithologist and artist. It was his last expedition. In August, 1927, shortly after his return, he was killed by an automobile-railway accident at Unadilla, New York.

As an artist Fuertes has left behind him a record which for all time will mark him as one of the world's greatest painter of birds. As a man he will live in the memory of his countless friends. When they are gone he will be known from the glowing tributes they have paid him, such, for example, as Osgood places at the end of this volume.

In the printed word Fuertes left almost nothing. His brush and field studies claimed all his time. How thankful, therefore, we should be for the publication of this day to day field journal in which Fuertes, unconsciously, gives us an outline sketch of himself. To help round out the story Osgood adds his journal and we thus have a dual account of each day's events.

After securing an outfit of 30 men and 50-odd mules and horses at Addis Ababa, the expedition divided into two sections of which Osgood,[1] the leader, and Fuertes formed one, while Bailey, Baum and Cutting made the other. Each followed different routes in pursuance of their somewhat unlike purposes. Together, they covered nearly 2000 miles in the saddle, made over 200 camps and, with the aid of native helpers, collected nearly 2000 birds and an equal number of mammals.

Baum has already published his story of the section to which he was attached, and the present volume completes the narrative of *Savage Abyssinia* (Sears), what was evidently a well planned, successful undertaking.

Although his duties as a collector of birds and the demands of camp-life must have made constant demands on Fuertes' time and strength he nevertheless secured one hundred paintings of birds. As a whole they are far and away superior to anything he had before made in the field. He seems to have been inspired by fresh, keen reactions to totally new experiences.

The entire lot were presented to the Field Museum by Suydam Cutting, who subsequently defrayed the expense of adequately reproducing 32 of them for inclusion in a portfolio issued by the museum. The 16 plates here included were selected from that portfolio. Only a few of them are finished drawings, and from these we name the frontispiece of a kingfisher and head of a tawny eagle (facing p. 98) as representative of Fuertes' ability to depict not alone a bird's portrait, but its personality as an individual.

The inclusion of photographs would have increased the value of the text not written for publication in its present form, and the addition of an index would have made more readily accessible the large amount of information the volume contains.

F. M. C.

MORE SONGS OF WILD BIRDS

- - - - - - - - - - - - by Albert R. Brand

Thomas Nelson & Sons, $2.50

THE title of this volume might well read "More and Better Songs of Wild Birds," so greatly have Mr. Brand's records of birds' songs improved over those presented with his earlier work in 1934. The text, also, shows the well-considered results of added research and the work as a whole expresses the notable progress that Mr. Brand and his associates at Cornell have achieved in a field that they have made their own. Moreover, Mr. Sutton's line-cuts of the *dramatis personae,* in some mysterious way, seem to add a note of realism to the records.

It is these records that give the book its distinctive character. Wholly aside from their value as tangible contributions to the physics of bird song, I think of them as reaching three classes of listeners:

First. Those who will use them as aids in identifying the originals and who will unquestionably find them helpful in this capacity.

Second. Those who are familiar with the originals and will find most of these reproductions marvelous but some of them libelous.

Third. Those who have not, and probably never will, hear the originals and who, in spite of Mr. Brand's warning, will accept these records as adequate presentations of them.

When, for example, I recall, vividly, my impression of the Pine-wood Sparrow's song as first I heard it, 50 years ago, I hate to think that others will gain *their* first impression of it from what, in the light of an imperishable memory, is to me an inadequate record.

I fear, therefore, that I am *not* among those who, to quote Dr. Allen's "foreword," "do not mind the march of progress into the woods and fields," nor can I, to quote again, "accept strawberry jam in December" as a satisfactory substitute for strawberries in June.

F. M. C.

GONE SUNWARDS

- - - - - - - - - - - - - by Cecil Roberts

Macmillan, $2.50

IF you aren't going to Florida this winter, get a copy of Cecil Roberts' *Gone Sunwards,* settle comfortably in front of the fireplace and be assured of as fine a picture of that much ballyhooed winter paradise as words can give.

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[1] See an article on Ethiopia by Dr. Osgood in NATURAL HISTORY for April, 1935.

By the time you are half way through the book, you should, if there is any suggestibility in your makeup, be ready to pack your grip and board the next train or boat bound for the land of sunshine, booms, and orange groves. If you do so, take the book along with you. It contains a wealth of fascinating lore about Florida's background and history with much of which even the most inveterate Floridan is unacquainted.

Author Roberts is a Britisher and he came from faraway London to winter on the Gulf Stream. He knows his way around Florida and his visit is set down in smooth-flowing language well sprinkled with the anecdote and shrewd comment of a man who is an expert traveler as well as an accomplished writer.

If there is a fault in the book, it lies in the fact that Mr. Roberts has "written up" Florida a trifle too glowingly in spots. He affects a certain slavishness before the extravagant resort life that is rather surprising in one of his proud and allegedly phlegmatic race, and he indulges occasionally in that suavely ingratiating humor, of the Oscar Wilde-Michael Arlen-Noel Coward school, which this reviewer finds personally unpleasing. Too high praise cannot be given, however, for the author's treatment of the landscape and wild life of the state. His description of the Everglades is most compelling, and his eye for the beauties of Nature throughout Florida is alert and unerring.

JABO PROVERBS FROM LIBERIA: INTERNATIONAL INSTITUTE OF AFRICAN LANGUAGES AND CULTURES

- - - - - by George Herzog (with the assistance of Charles G. Blooah)

Oxford Press, $2.50

TO the Jabo tribe of Eastern Nigeria the proverb or parable is a vital mechanism. The integration of life can be summed up in a proverb. The new is incorporated in the formalized generalities of the old. A multitude of segregated themes in the native's life are simplified and made comprehensible by the encompassing proverb. "When it rains the roof always drips the same way (15)," shrugs the Jabo man in explanation of the immutability of certain laws.

The proverb has a real function in native law. Trials are an exhibition of the lawyer's skill in remembering and applying proverbs. Even the linguistic form of the proverb is adapted to oratorical and poetic effect.

Dr. Herzog has made an admirable selection of proverbs, parables, and maxims. He presents them in classified order according to the subject matter involved, and the range is wide. The proverb is printed in the phonetic equivalents of the Jabo tongue with a word for word interlinear translation. This is followed by a free translation. In most cases additional information is necessary to explain the allusions, interpret the amazing imagery, and to give examples of actual situations in which the proverb is used. Some of the sayings are readily understandable without much further comment, such as: "The tree grows up before we tie a cow to it (31)," which implies that experience is demanded before much trust is placed in a man. On the other hand; "If a Man is not seasoned, he will split (306)," takes on significance with Dr. Herzog's explanation that rice, before being pounded, must be thoroughly dried to avoid its splitting and becoming awkward to handle.

As Dr. Herzog points out, many of the proverbs are prefaced by the designation of the speaker: "Crab says: if you see your fellows in the mud, you join them (55)." Since one species of land-crabs gather in great numbers in muddy spots, it is appropriate that the crab should speak. Or, in another example; "Chicken says: if you scratch too hard, you come upon the bones of your mother (107)." While this refers to the fact that chickens scratching in the village trash-heap may find their mother's bones, it is used to quell gossips.

The book is delightfully written. Mr. Blooah, who assisted Dr. Herzog, is himself a Jabo with education at the University of Chicago. His explanations and comments are indicated in the book and they have not been greatly changed from their original flowery style.

The rather formalized presentation of the material in no way detracts from its intrinsic charm and readability. In fact any less formal arrangement would seem forced. The student of folk-lore is given comparative references both in the text and in an appendix at the back. The sociologist and psychologist will find the classification of proverbs a positive aid. The general reader will find amusement and fascination in this intimate picture of the Jabo thought patterns and customs. "A man's ways are good in his own eyes (212)."

W. C. BENNETT.

THE STORY OF HUMAN ERROR

- - - - - - - - Edited by Joseph Jastrow

D. Appleton-Century Company, Inc., $3.50

HARLAN T. STETSON, C. Judson Herrick, Harry Elmer Barnes, and many other leading scientists have contributed to this novel symposium on the "false leads" in the development of science. Professor Jastrow has ably edited the book and also written sections of it himself. The story is divided into two parts: part one, *The World,* deals with the cosmic, physical and living realms, and part two, *Man,* concerns the human realm of science and its application in sociology, medicine and psychiatry. Each essay takes the form of a synopsis of the history of the author's particular field of science with stress laid upon the errors revealed in that history.

Many of the mistakes of science have been errors of observation and description, but by far the greatest number are errors of interpretation and causal relationship. In the earlier history of science faulty interpretations were frequently the result of the argument by analogy, which may be illustrated by the fact that walnuts were once prescribed for brain trouble because the hard shell remotely resembles the skull and the softer, convoluted kernel resembles the brain. The errors of modern science are largely what Professor Parshley in his essay on zoölogy calls *tentative,* that is, "errors inherent in the scientific method of trial and error, which are consciously regarded as on trial before they are unmasked and discarded." In his essay on the science of physics, Dr. Swann has clarified for us the outstanding contrast in the old and new approaches to specific problems. "The hypotheses and dogmas of modern physics differ from those of the ancients not so much in the matter of artificiality as in the fact that modern hypotheses are *chosen* with Nature as a guide. They are chosen so as to fit Nature, whereas the hypotheses of the ancients were chosen ofttimes from principles having no immediate connection with Nature or with the branch of it under discussion, and this choice was then followed by an attempt to force Nature into them." Dr. Swann's statement summarizes in essentials the views of his co-authors, and forms a basis for the understanding of the scientific error so prevalent among the early philosophers.

The Story of Human Error merits a careful study by those interested in the future of science as well as its past history. These sixteen scientists have laid bare the mistakes of their ancient colleagues and several of their contemporaries as they trace the gropings of humanity toward a more perfect understanding of its environment. The book as a record of events up to the present day is well organized and quite complete. As we of today judge the science of the past, so, perhaps, shall we in turn be judged in the light of a higher knowledge of the future, for the chronicle of human error is as endless as humanity itself.

G. MILES CONRAD.

Science in the Field and in the Laboratory

Fossil findings — Astronomy Exhibits and Lectures — Bird News—British-Columbia Expedition

Fossils

Doctor Barnum Brown, Curator of Fossil Reptiles in the American Museum of Natural History, recently returned from the west, where he visited several National Parks and made important discoveries.

Doctor Brown, accompanied by Mr. R. T. Bird, of the laboratory staff left New York August 22nd by motor car to make a special examination and report on the great Dinosaur National Monument near Vernal, Utah, for the National Parks Service, with which the American Museum of Natural History is cooperating in developing this important educational park.

"The Dinosaur National Monument," said Doctor Brown, "is located near the main highway between Salt Lake City and Denver, in northeastern Utah, where the highway U. S. 40 crosses Green River. At this point surrounding Split Mountain, the sedimentary rocks are tipped up at an angle of 80 degrees, brilliantly colored, and are composed of Mesozoic sediments that accumulated during 50,000,000 years.

"One stratum of Jurassic sandstone that was deposited approximately 140 million years ago carries untold numbers of dinosaur remains; in fact, complete and partial skeletons of practically the entire dinosaur fauna of the Jurassic period now known from the southwestern United States.

"This rich dinosaur graveyard was first worked by the Carnegie Museum, which took out 7 carloads of fossils during a period of 14 years, after which the area was declared a national monument by the United States Government during the Wilson administration.

"Since 1931, Doctor Brown has been instrumental in directing the development of the Dinosaur National Monument and during the past few years, various groups of emergency workers have been making a great cut necessary to expose more of these skeletons buried in the rock. During the past year, the project was taken over by the National Parks Service, which is to continue the development and complete the cut—190 feet long, 40 feet wide and 30 feet deep—removing many thousands of cubic yards of stone and clay.

"After the cut has been made American Museum representatives with air-chisels, will "sculpture" out in relief, the skeletons embedded in the sandstone, thus exposing the remains which originally had been lying horizontal before the mountain's uplift. The reliefing is a slow and careful process and can be done only by experienced technical workers. After this work is completed, the government will construct a building of which this large fossil slab will form the entire northern wall. When the building is completed it is planned to place on the opposite vertical wall an enormous mural painting, showing the animals in their natural habitat millions of years ago, and in the center of the building accurate models of animals whose bones lie embedded in the opposite wall.

"The government will develop a water system, houses for maintenance, parking grounds and facilities for unlimited numbers of automobile visitors. The State of Utah will construct the road leading from the main highway to the monument, which is planned to be one of the greatest in educational value of all the National Parks."

After completing his survey at the Monument, Dr. Brown went on to the Painted Desert near Cameron, Arizona, where he was joined by Mr. G. D. Guadagni of Boston. There, in the lower Triassic strata, on the Little Colorado River, the party discovered and unearthed the skull, jaws, several vertebrae and humerus of a large alligator-like creature that is new to science. The size of these bones indicates a reptile 30 feet in length, which would stand about 4 or 5 feet in height. This reptile is quite evidently new, as the teeth are like those of a phytosaur, and the 4-foot skull is extremely broad, with a rounded snout, whereas the skulls of phytosaurs are narrow and pointed.

It was near this spot that Doctor Brown excavated many hitherto unknown dinosaur tracks in the lower Triassic, and Permian rocks. In the Little Colorado River Valley Doctor Brown had previously discovered 42 standing tree trunks in one group in 1901 and these stumps were relocated.

In the region of the Petrified Forest many interesting rare Triassic plants were secured for exhibitions in the Dinosaur Hall.

On the return trip to the east, the party stopped at the farm of William Thompson, near Argos, Indiana. There, they excavated the bones of a mastodon, lying so close to the surface that plows had broken the skull. The tusks, limb bones, foot bones, most of the ribs and several vertebrae and the pelvis were recovered. Doctor Brown believes this mastodon died about 10,000 years ago, and the position of the animal showed it must have bogged in the quicksand which still underlies the cornfield of today. In the moist, peaty material surrounding the remains were Pleistocene shells and many of the plants, seeds and pieces of wood of that time. Cones from trees similar to present-day junipers and pine indicate that those trees were plentiful in that region during the Pleistocene period. Today, the pines and junipers have almost disappeared from this part of Indiana.

Mr. Guadagni drove from Boston to the Big Bend of the Rio Grande, Texas, where he excavated for the Museum one of the largest and best preserved Cretaceous palm leaves known, which is to be exhibited in the Hall of Cretaceous Dinosaurs.

Next month Doctor Brown is expected to publish an article and a series of photographs in NATURAL HISTORY illustrating this trip.

Planetarium News

On the second floor of the Planetarium, in an exhibition case near the North Entrance to the Planetarium dome, is an interesting exhibit of specimens collected by Dr. Clyde Fisher on his recent expedition to the meteor craters in Estonia. These specimens include burnt dolomite rock and powder from the craters, as well as shells of gastropoda found at the time of excavation beneath the layers of dolomite.

An interesting exhibit of seven pencil drawings of the moon is on view on the bulletin board, first floor of the Planetarium. These drawings are the work of Mr. Arthur-Louis Sands, of Newton, Massachusetts.

The Christmas Stars is the subject of the Planetarium lecture for the month of December. The heavens will be shown as they appeared two thousand years ago at the time of the birth of Christ, with the Star of Bethlehem shining in the sky. Various theories will be presented concerning the real identity of this famous object which has been the subject of so much debate and research.

On December 3rd the third in the current series of special lectures will be given by Miss Dorothy A. Bennett, Assistant Curator, on the subject *Wandering Worlds*. On December 17th, Miss Marian Lockwood, Assistant Curator, will present the fourth lecture in the series, on *The Glorious Aurora*. These lectures are on Thursday evenings from six to seven o'clock. Since they form part of a series, no single tickets will be sold. The subscription fee for the six lectures is $2.50.

A celestial navigation course consisting of twenty-four two-hour lessons in the principles and practice of both aerial and marine navigation is offered. Four of the periods will be held in the Planetarium dome. The other twenty will consist of lectures, actual observations, computations and use of instruments. All lectures will be conducted by outstanding authorities. The tuition for the entire course is fifty dollars. Although some of the meetings have already been held, those who are interested may apply for further information to the Planetarium office.

The meetings of the Amateur Astronomers Association are now held in the Auditorium of the Roosevelt Memorial Building, entrance on Central Park West at 79th Street. On December 2nd, Professor C. A. Corcoran, Chairman of the Physics Department of the College of the City of New York, will speak on *Gravitation and Relativity*. On December 16th, Mr. Leo Mattersdorf, Third Vice-President of the A. A. A., will speak on *Eclipses*. These meetings begin at 8:15 promptly and are open to the public. Various interesting classes, both elementary and advanced, are also carried on by the society. Information concerning these can be obtained by communicating with The Secretary, A. A. A., Roosevelt Memorial Building, American Museum of Natural History.

During December the following radio talks will be given over Station WHN under the auspices of the Amateur Astronomers Association. The time is Friday, 6:30 to 6:45 P. M. Watch your daily newspaper for possible change of date.

December 4—*The Christmas Star*—by Mr. William H. Barton, Jr.
December 11—*Terrestrial Magnestism and Solar Activity*—by Mr. Joseph L. Richey.
December 18—*The Winter Solstice*—by Mrs. Virginia Geiger.
December 25—*The Winter Sky*—by Mr. Charles A. Federer, Jr.

The meetings of the Junior Astronomy Club are now held in the Roosevelt Memorial Auditorium, entrance on Central Park West at 79th Street. On December 5th, Mr. Hubert Bernhard will speak on *The Human Side of the Stars,* and outdoor observations will be carried on. On December 19th there will be a competition on the subject of the Two-Hundred-Inch Telescope. These meetings are open to the public and are held on Saturday afternoons at three o'clock. Information concerning the activities of the group may be obtained by communicating with *The Junior Astronomy Club,* The Roosevelt Memorial, American Museum of Natural History.

The monthly journal, *The Junior Astronomy News,* is published by the Club from December to May, and includes the advance Astronomical Calendar as well as popular material on the science.

Ornithology News

Dr. James P. Chapin is continuing his studies of the birds of central Africa at the Musée du Congo Belge in Tervueren where every facility for prosecuting his work has been given him.

With the opening of the Roosevelt Memorial the Collection of Birds found within 50 miles of New York City has been moved to the ambulatory on the first floor (driveway entrance) of that building. Here better light and increased space permit of its more effective display as well as of additions to the section containing the Birds of the Month. The individual, accessory groups showing the nests and eggs of local bird's, which were formerly placed with the local collection near the lunch-room, have been temporarily moved to the alcoves in the Hall of Flying Birds.

The Annual Meeting of the National Association of Audubon Societies was held in the lecture hall of the Roosevelt Memorial October 26-27th. The program included reports from the leaders in the many fields in which the Association is now active and also papers by authorities on diverse types of conservation. The whole was well designed to impress one with the progress shown by modern methods of conserving wild-life and its haunts.

Mr. Kermit Roosevelt was reelected President of the Association and Mr. John H. Baker its Executive Director.

The Department received an interesting collection of about 170 birdskins from Tanna, New Hebrides, one of the few islands of the South Seas not visited by the South Sea Expedition. The particular interest of this island is, that it was discovered by Cook on one of his memorable voyages through the South Seas, and some birds were collected by his naturalist, Forster, which were described by Latham and Gmelin. Mr. L. Macmillan not only succeeded in getting some of these typical Tanna birds, but he also added several species to the Tanna list, two of which were unknown to science.

Dr. Mayr is now actively engaged in the working out of the birds of the Vernay Hopwood Expedition to the upper Chindwin River (see this magazine, vol. 36, p. 37). He finds that the birds of this district form an interesting transition fauna between a western element, coming from Assam, northeastern India, and an eastern element, coming from northern Indo-China and southernmost Yunnan. On the other hand, there is very little relationship with the birds of further south (Siam and Tanasserin).

The collections of the Bird Department continue to be of service not only to the members of the Museum staff but also to workers in other institutions. During the last few weeks the Department has been visited by a number of ornithologists and friends who have examined material in the Museum collections and have also inspected the new quarters of the Department in the Whitney Wing. Among the callers have been Dr. Jean Delacour of Châteaux de Clères, France; Mr. C. M. B. Cadwalader and Mr. James Bond of the Academy of Natural Sciences, Philadelphia; Mr. A. L. Bailey of Colorado State Museum, Denver, Mr. I. M. Gabrielson, Chief of the Biological Survey, Washington, D. C., Mr. J. J. Darling, former Chief of the Biological Survey, Mr. Alexander Sprunt of Charleston, S. C.; Dr. Casey Wood, of Chicago; Mr. Randolph Jenks of Morristown, New Jersey and Arizona; Mr. J. C. Greenway of the Museum of Comparative Zoölogy, Cambridge, Mass.

Recently, also, specimens have been sent on loan to Dr. Claude B. Ticehurst and Mr. N. B. Kinnear of the British Museum, London, Dr. Herbert Friedmann of the United States National Museum, Washington, D. C., Dr. H. C. Oberholser of the U. S. Biological Survey, Washington, D. C., and Mr. James L. Peters of the Museum of Comparative Zoölogy, Cambridge, Mass.

William F. Coultas is in the field on the Crocker Pacific Expedition securing material for certain groups of birds to be installed in the Whitney Memorial Hall. He writes from Samoa that he has been quite successful in obtaining material from that group of islands.

On alternate Tuesday evenings beginning on October 13th, Dr. Robert Cushman Murphy has been conducting a well attended course for members of the Museum. His general subject is entitled *The World of Birds* and the course is this season's contribution to the "Know Your Museum Series" which has been increasingly popular since it was first organized by the Museum's Department of Education.

The subjects of the lectures thus far given are *The Bird's Place in Nature, Methods of Bird Study,* and *The Geography of Birds.* Each talk has been followed by an informal conference and by visits to various exhibition halls and to the laboratories and study collections of the Department of Birds. Aspects of bird study thus far considered include the following: fossil birds; the affinities, evolution and adaptive radiation of birds; living birds in the experimental laboratory; modern bird watching in the field; environmental tolerances and their significance; birds as indicators of life zones on land and sea.

The concluding lecture of the series on November 24th, on *The Behavior of Birds*, dealt with learned and unlearned responses in birds, the extent of their intelligence as compared with that of other animals, and the significance of territory, courtship, migration and other patterns of activity which throw light upon the mind of animals in general.

Rumsey-British Columbia Expedition

The acquisition of a fine series of big game and small mammals from northern British Columbia was made possible through the splendid cooperation of Mr. E. Roland Harriman and the generous support of Mr. Bronson H. Rumsey. The members of the expedition included Messrs. John P. Meade and John W. Pitney, who proved of valuable assistance in the capture and preservation of specimens, and Mr. Dawson A. Feathers, American Museum representative and official collector. After two months in the field, the expedition returned early in October, bringing back six Stone sheep, five mountain goat, three caribou, and one grizzly bear. It is interesting to note that one of the sheep taken by Mr. Pitney is the second largest Stone sheep on record, the horns measuring 45 inches in length, with a base of 16½ inches, and spread 25 inches. In addition to the big game animals, are 150 specimens including beaver, otter, lemmings, and other small mammals, such as shrews and rodents.

Characteristic of the difficulties that overtake those who tarry too long in the mountains of the Northwest, the Rumsey-British Columbia Expedition was caught at Deadman's Lake in a blizzard. of unprecedented magnitude for the season. Between five and seven feet of snow fell in a continuous storm that lasted four days and four nights, and it was only through the fine heroic work of everyone concerned that they were able to get out without losing a number of horses, and bring out their trophies.

Amateur Telescope Making

The Hayden Planetarium and The American Museum of Natural History, in cooperation with New York University, Division of General Education, offers a course in

Amateur Telescope Making
By Ramiro Quesada
Beginning Thursday, December 3, 1936
At 7 P. M.
At the Hayden Planetarium Optical Workshop,
81st Street and Central Park West.

This course consists of a series of twenty-four lessons of three hours each, during which time the student will have the opportunity, not only to learn the technique of telescope making, but will be expected to complete a telescope mirror which will become his own property at the end of the course. This will provide him with the major item for his observatory. Special mechanical ability or previous knowledge is not required. The fee for the course, including necessary supplies, will be $35.00. Facilities for registration will be provided at the first session, but inasmuch as registration is necessarily limited by the workshop facilities, the student is urged to send his application, with fee to

PROFESSOR H. H. SHELDON
Division of General Education
New York University
20 Washington Square North
New York, N. Y.

This course is an outgrowth of one conducted by Mr. Quesada for the Amateur Astronomers Association for many years in the past. Many amateurs have made exceptionally good mirrors with the aid of Mr. Quesada's instruction and experience. This presents a real opportunity for the person who knows nothing about telescope mirror making to start from the very beginning and end with a very useful glass.

The class will meet each Thursday night from 7:00 to 10:00 P. M., unless the registration is sufficient to require a second group meeting each Tuesday night for the same time. If further information is required, address Professor Sheldon, as above. Anyone interested is invited to attend the first session of the course on December 3rd.

Student Science Clubs Christmas Program

The annual Christmas science program of The American Institute Student Science Clubs will be held as usual at the American Museum on December 28 and 29. Participation in this program is open to all of the Institute's member science clubs in New York City and suburbs.

The Christmas Lectures will be held at noon on each of these days, with two world-famous scientists or explorers speaking on each program. This year Dr. Harlow Shapley of the Harvard College Observatory will speak. And either Dr. Hugo Eckener or Captain Lehman of the new German dirigible "Hindenberg" will also appear. The other two speakers will be announced at a later date. These lectures will be broadcast over a national hook-up so that all science clubs and all young people interested in science over the country may have the opportunity of hearing them.

The Christmas Lectures are modeled somewhat on the Christmas series held by the Royal Institution of London for over a century. The British series have been conducted by such brilliant scientists as Faraday, Tyndall, Bragg and others. It is the plan of The American Institute to provide an opportunity for the young people of America also to hear the world's great scientists. In the past two years such men have appeared on the Institute program as: Dr. Harold C. Urey, Nobel Prize Winner in Chemistry, Dr. W. F. G. Swann, Director of the Bartol Research Foundation of Swarthmore, Captain A. W. Stevens, Commander of the 1935 Stratosphere Flight—the highest ever made, and others.

The Science Congress for clubs will also be held on these two days. The Congress is based in plan on meetings of the American Association for the Advancement of Science, with section meetings on a variety of science subjects held simultaneously. At these meetings members of the clubs read papers or give demonstration talks of their researches in the clubs during the school year. A junior club member acts as the chairman of each meeting and leads the discussion which is invited after each paper is read. Prominent scientists are asked to attend the meetings as an honor to the speakers, but they take no part in the program which is conducted entirely by the boys and girls themselves.

In the past papers of great merit have been presented. And meetings on many specialized subjects have been arranged, including such general topics as: Genetics, Microscopy, Cinephotomicrography, Photomicrography, Electrified Gases, Light Waves, Aerodynamics, Airplane Construction, Chemistry of Visible Particles, Applied Chemistry, Combustion, Biology, Biological Preparations, etc.

Fresh-Water Fishes

Mr. Michael Lerner, Field Associate of the Department of Fishes, and Mrs. Lerner sailed on November 14th to spend several months in Africa. While there, Mr. Lerner plans to collect fresh-water fishes for the Museum's collection.

Charles Hayden

At a meeting of the Board of Trustees Charles Hayden, the donor of the Planetarium instruments and in whose honor the Planetarium is named, was last month elected a Trustee of the American Museum of Natural History.

RECENTLY ELECTED MEMBERS

SINCE the last issue of NATURAL HISTORY the following persons have been elected members of the American Museum:

Patrons

Mrs. George B. deLong.
Mr. Frazier Jelke.
Mrs. Marion Brown Shelton.

Life Members

Messrs. Nicholas Cox, David Adam Turner.

Sustaining Members

Messrs. James Fleming, Charles W. Giles, George S. Turner.

Annual Members

Mesdames Harry Alexander, S. Remsen Bishop, George Cerio, Bertram Cutler, Frank L. Driver, A. Erdmann, Paul Hammond, Sidney B. Haskell, F. C. Hawkins, H. L. Lloyd, Katherine H. Mantius, Frank R. Oastler, Frank Spiekerman, Ernest Sturm, Alden H. Weed.

Misses E. C. Boetticher, Jane A. Catlin, Martha D. Havens, Cornelia Roovers, Lillian Willard.

Reverend Francis P. Heavren.

Colonel Oliver J. Troster.

Doctor Walter C. Alvarez.

Messrs. Andrew Anderson, Albert A. Arnheim, Alvin J. Arnheim, F. E. Barbour, Mortimer Brenner, Harold Cowan, Harward W. Cram, Edward P. Doyle, William Eastman, Chas. R. Esdorn, Louis A. Falk, John C. Flynn, Wm. C. Gregg, Robert M. Hillas, Chandler D. Ingersoll, Henry Judson, J. Allen Julier, J. A. Keller, Achille Laevens, Harold I. Leiman, Edward D. Lentilhon, Harry I. Luber, Edward S. Malmar, Thomas F. McCarthy, Thomas N. Metcalf, L. A. Robb, Murray Rushmore, Albert F. Sadler, Max Schnefel, George Frederic Sibley, Jr., Frank J. Smith, Edwin A. Stumpp, Maxwell Tausek, Arthur Van Raalte, Philip G. Whitman, Ramsay Wilson.

Associate Members

Mesdames Mary H. Bacher, Fannie K. Baiter, Irving Barrett, Julius Bliss, F. Brieger, Harriet Burd, Frederic M. Burr, Peter L. Cherry, Ernest B. Dane, Charles E. Denney, Robert D. Eggleston, Carlton L. Ellison, Chas. Es'Dorn, Edward Fineberg, Edith C. Gleason, Frank L. Graham, S. C. Hawley, Nils Hogner, G. W. Hooker, Chauncey M. Hooper, Arthur Huck, Edith C. Huntington, Emma Y. Ivine, Thomas T. Kent, Johanna Kuser, Edwin K. Latz, James F. Lawrence, Isabel M. Lewis, Marion Foster Loizeaux, W. F. Maurer, John Doull Miller, Worthen Paxton, J. M. Shear, Alethea A. Stewart, L. G. Swinney, Frank M. Talbot, Clara K. Taylor, Dwight True, R. W. Van Pelt, J. D. B. Vreeland, Emma H. Wendland, Ezra Williamson, Edwin A. Winchester, Percy Wisner.

Misses Josephine H. Abbott, Grace Afflerbach, Alma C. Arnold, Henrietta Bancroft, Vida C. Beck, Betsy Blackwelder, Merce E. Boyer, Mary C. Brodie, Mary Aveline Butler, Anna Carson, Mildred R. Casey, Lenox E. Chase, Anna S. Courtenay, Joan Cummings, Mary B. Cushing, Mary E. Dillon, Isabel F. Dodd, Anna Forman, Grace Adams Glen, Helen E. Glenzing, May T. Gunter, Sybil V. Hunter, Gertrude M. Jacobs, Marie Johnson, Sara S. Lawrance, Carrie A. Longfellow, Rachel Lustig, A. Mantle, E. P. Martin, Florence Moynihan, Louisa F. Palmer, Edith Peterson, Jean K. Proctor, Elaine Lucille Rachlin, Ada I. Sanness, Jennie L. S. Simpson, Kathryn Stern, Josephine Tark, Pauline Vonnegut, Clara E. Walmsley, Vida M. Watkins, Kate T. Wendell.

Reverend John W. Baechle, Roberto Ramirez.

Lieut. Cdr. Paul E. Gillespie.

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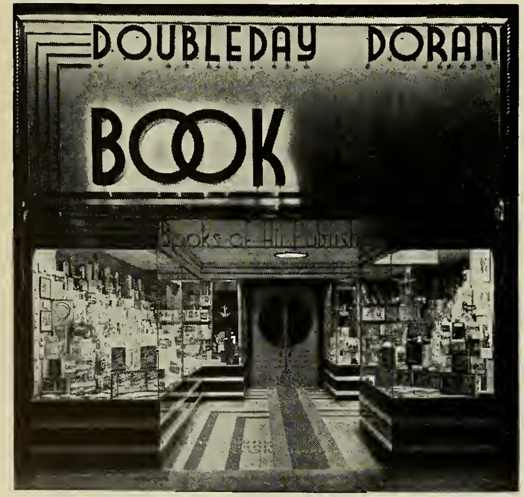

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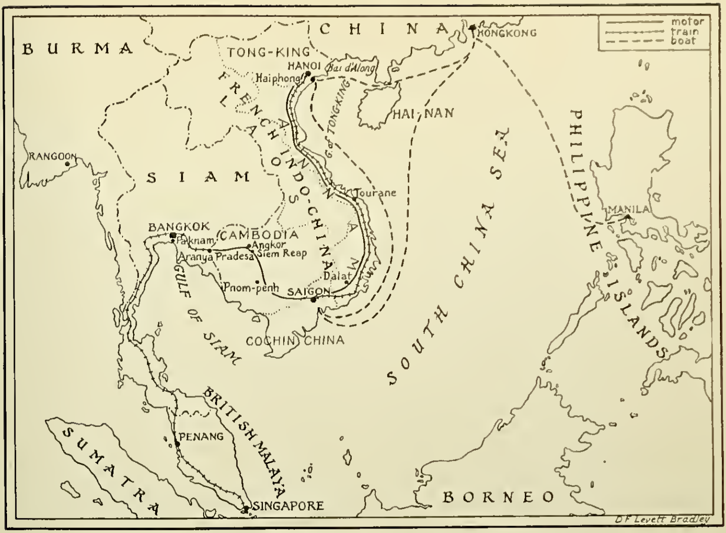


PASSPORT TO *INDO-CHINA*

THE photographs of Indo-China, contributed to this issue of NATURAL HISTORY by Dr. James L. Clark, Director of the Department of Arts, Preparation and Installation, will give you some idea of the unusual interest of a country that is seldom visited in the ordinary course of travel and yet can quite easily be included in a trip to the Orient or a round-the-world cruise. Although the principal steamship routes from the United States do not touch at the ports of Indo-China, by adding a few extra days this fascinating country can be included in your itinerary. The two main points of departure for a detour to Indo-China are Hongkong (westbound), or Penang on the Malay Peninsula (eastbound). From Hongkong it is only 2½ days by steamer to Saigon and from Penang, two days by train and motor to Angkor via Siam.

BIG GAME COUNTRY: Besides the remarkable ruins at Angkor to recommend it as a place of interest to NATURAL HISTORY readers, Indo-China provides an opportunity for the most timid traveler to see for himself the big game country pictured in the pages of this magazine. Here, the life of the jungle begins at the very doorstep of civilization. Doctor Clark, in telling of his recent expedition, says, "Along the main motor highway from Saigon to Hanoi could be seen tiger tracks and evidence of elephants in the vicinity. The latter frequently uproot the railroad signposts and trample the palm trees alongside the road." There was always the danger that an elephant might inadvertently walk into camp at night and yet, every morning fresh rolls were delivered by train from Saigon for breakfast.

HANOI: The length of time can be devoted to a visit to Indo-China will determine not only what to see, but the route. If your time is limited you can transfer to a boat at Hongkong that will take you direct to Saigon. From Saigon, it is a short two-day motor trip to Angkor, where at least two days should be allowed for visiting the ruins. From Angkor to Penang, where one can pick up one of the larger ships again, takes approximately three days. Although hurried, the entire trip can be made in little over a week. If three weeks or more can be added to your itinerary for the trip to Indo-China, you can take a coast-wise ship at Hongkong for Haiphong, the port for Hanoi, instead of sailing direct to Saigon. The journey from Hanoi, in the Northern province of Tong-King, to Saigon in the South, takes in some of the most beautiful scenery and points of interest, including the locale of Doctor Clark's expedition, in Indo-China. Hanoi, itself, is well worth a visit. An ancient capital, it has been modernized by the French who have occupied it since 1900. A day's sightseeing in Hanoi can include a walk or rickshaw ride around the Petit Lac, a lake in the heart of the city with a charming temple built on its Isle of Jade; the Botanical Gardens and the Mot-Cot, or Pagoda of the Single Pillar.

From Hanoi it is about a one hundred-mile motor drive to Hongay on the Bay of Along, one of the most beautiful bays in the world. At Hongay you can hire a launch to take you out for a day's excursion on the Bay, visiting some of the fascinating islands that once supplied a haven for pirate fleets. One should be sure that a tender is included for landing at the islands, also a flashlight for exploring the caves. Although the round trip can be made in a day from Hanoi, there is a hotel at Hongay for those who wish to stay longer.

The trip from Hanoi to Saigon can be made in two days by train and cars may be hired for sightseeing at the various stopping places. If one can afford the additional time and cost, to go by motor, which requires approximately a week, is more interesting and pleasant. Both modes of travel follow the coast through Hue, Tourane and Dalat. In the country around Tourane lived the Chams, who were among the chief enemies of the Khmers of Angkor and who helped to destroy the ancient Khmer civilization. Scattered through the jungle are the remains of the temples and other buildings of the Chams. Some of these may be seen from the main motor road. A stop should be made in Tourane to visit the Museum which contains the most famous collection of Cham sculptures in existence. From Tourane, also, a short excursion can be made to the Marble Mountains where centuries ago pious Buddhists built sanctuaries in the cliff caves. This trip can be made by motor or launch and takes only half an hour each way.

SAIGON: From Tourane to Saigon you pass through the low-lying coastal country of Annam with its tropical jungle where wild life and civilization meet—a modern motor road with tiger tracks, with the sound of elephants in the nearby bush at night and a glimpse of wild peacocks in their native habitat. When you arrive at Saigon, you will find a miniature Paris transported into the jungle. As there is a large European population and continental atmosphere many days could be pleasantly spent in Saigon but if your time is limited to sightseeing, a tour of inspection can be made by motor or rickshaw, including the suburb of Cho L'On.

PHNOM-PENH: There is no railroad from Saigon to Angkor; one goes by motor. Scheduled motor buses make the trip regularly but are not as comfortable. The cost of a private motor from Saigon to Angkor is approximately $60.00, and the trip requires two days with a stop over-night at Phnom-Penh. By leaving fairly early in the morning you can arrive at Phnom-Penh, the capital city of the King of Cambodia, in the afternoon in time to do all your sightseeing the same day. The chief place of interest is the Royal Palace with its crown jewels, ornate halls and stables of sacred white elephants. Not far from the Palace is the Museum which contains an unrivaled collection of Khmer and pre-Khmer art. On the way from Phnom-Penh to Angkor you will pass the ruins of many ancient Khmer buildings.

ANGKOR: The highlight of any trip to Indo-China is a visit to the remarkable ruins of the ancient Khmer civilization at Angkor. Dr. Harry L. Shapiro, Associate Curator of Physical Anthropology of the American Museum, says of Angkor, "The most frequently figured of all Khmer monuments in Cambodia are the ruins of Angkor. The Angkor-Wat is a work of art, a masterpiece of architecture, and the tourist may spend days without ennui wandering about seeing ever new aspects of startling beauty; the student may spend years of absorption trying to encompass all that were worthy of study."

A millennium ago Cambodia was the scene of one of the proudest kingdoms in the Orient. Today, although the French have cleared the jungle and skilfully restored in part the gravest ravages, the process of disintegration is everywhere evident in the spectacle of massive stone buildings enwrapped in the roots of giant trees. The sources of information concerning the life, the history and origins of the Khmers have been principally the Sanscrit inscriptions found on the walls of buildings, the bas reliefs which decorate the galleries of the temples and factual accounts written by early Chinese travelers. One of these, writing in the Thirteenth Century, described the glory of Angkor at its proudest, the royal processions, the towers of gold and ivory, the rich temples assigned to the worship of the Brahmanic and Buddhistic pantheons, and the hordes of slaves captured in war that characterized this reign of luxury. It is at present established that Khmer architecture has a history which goes back at least to the Fifth or Sixth Century and terminates in the Thirteenth. For centuries after the disintegration of the Khmer empire the magnificent buildings at Angkor were swallowed by the jungle. The first intimation that came to the west of the existence of this lost city was in 1601, but the modern interest in Cambodia may really be dated from their rediscovery by Mouhot in 1861.

The ruins of Angkor consist of the Temple or Wat, and of the city itself, Angkor-Thom. If you have only two days to spend at Angkor, one can be devoted to seeing the Angkor-Wat and Angkor-Thom and the other to taking the two regular sightseeing trips. However, it is advisable to spend a longer time if possible. The climate makes walking in the middle of the day extremely arduous. As in most tropical countries, foreign residents as well as the native population remain indoors from noon to about four o'clock. If you wish to be within walking distance—elephants are provided for those who prefer this romantic approach—of the ruins you can stay at Dak Bungalow in Angkor. There is a new hotel with more modern equipment at Siem Reap, twenty minutes from Angkor. On leaving Angkor you can either return to Saigon or motor the short distance to Aranya Pradesa, on the border of Siam, and from there take the train to Bangkok and Penang.

TRANSPORTATION: The possible combinations of steamship travel that can be arranged to include a visit to French Indo-China are too numerous to give a complete list in this article. However, the principal sea routes from the United States to Indo-China are as follows:

STEAMSHIP VIA THE ORIENT: To go to Indo-China by way of the Orient one may take any one of a number of first-class lines as far as Hongkong, China, or Manila and change at either of these points to a smaller line going to one of the ports of Indo-China. Or one may take one of the larger steamers as far as Singapore or Penang and from there take a train up to Bangkok, which is only a few hours from Angkor.

The Dollar Line round-the-world ships leave New York every two weeks for the Orient via the Panama Canal, including among their stops, Havana, San Francisco, Honolulu, Kobe, Shanghai and Hongkong. This trip takes about fifty days but can be shortened by embarking at San Francisco. Other lines sailing from the West Coast and touching at Hongkong and Penang are the N. Y. K. (Japanese) Line from California and the Canadian Pacific, which runs on a regular fortnightly schedule from Vancouver.

From Hongkong ships of the Messageries Maritime and Cie. Indochinois sail regularly to Haiphong or Saigon in Indo-China. The coast-wise ships, though small, are comparatively comfortable and make the trip from Hongkong to Haiphong, the port for Hanoi, in three days; or the larger vessels of the Messageries Maritime direct to Saigon in two days. On leaving Indo-China you need not return the same way but can pick up a Dollar Line or other first-class ship again at Penang and continue around the world or return to the United States by way of China and Japan.

STEAMSHIP VIA EUROPE: The best passenger line going directly to Indo-Chinese ports is the Messageries Maritime, which maintains a regular fortnightly service from Marseilles to Saigon. Arrangements can be made through the French Line (Compagnie Generale Transatlantique) for passage from New York to Saigon via France. The trip from Marseilles to Saigon, stopping at many interesting ports, takes approximately three weeks.

The trip, via Europe, may also be arranged through the Cunard Line, transferring in England to the Nippon Yusen Kaisha Line which goes to Penang and Singapore, where you can take a train to Bangkok, Siam and thence by rail and motor to Angkor.

CRUISE SHIPS: The Cunard White Star Liner, Franconia, sailing from New York January 7th on a cruise around the world, provides an optional tour to Siam and Indo-China. From Penang, on the Malay Peninsula, the trip is made by special train via Bangkok to Angkor where two days are allowed for sightseeing.

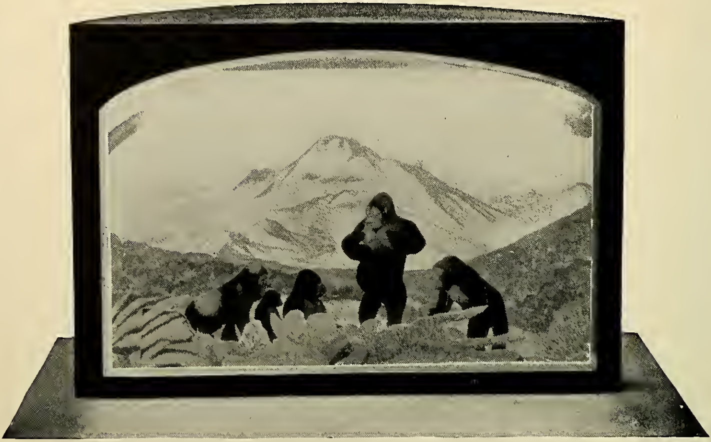
The Empress of Britain world cruise, leaving New York January 9th, includes an optional tour to Bangkok and Angkor. Cruise passengers taking this trip leave the ship at Penang on March 1st and rejoin it at Paknam on March 6th.

BY AIRPLANE FROM CALIFORNIA: By the time this is printed it is expected that the Pan-American Airways will have included the final stage of its route, from Manila to Hongkong, in its schedule. A Pan-American Clipper Ship leaves San Francisco every Wednesday, taking five days to Manila with over-night stops at Honolulu, Midway, Wake and Guam Islands. From Manila to Hongkong on the Clipper will take an additional six or seven hours. The cost of the trip from San Francisco to Hongkong will be approximately $900.00.

CLIMATE AND CLOTHES: As more than a thousand miles separates the northern and southern extremes of Indo-China, the climate varies. Saigon and Angkor, near the equator, have tropical heat the year round and only the thinnest clothes are required, while Hanoi, in the north is cold enough at certain seasons to require a warm coat. November, December and January are the best months to visit Indo-China. February and March can be included. April and May are the most uncomfortable.

WHAT TO BUY: Perhaps nowhere in the world will you find silver displaying such fine workmanship, and at so low a price as in Indo-China. The Museum at Angkor is the local agent for the native craftsmen and is the best place in which to buy silverware, although it is also sold in the shops in Saigon. Other native products which are well worth bringing home are carved camphor chests, carved stone antiquities and pottery.

There is scarcely a quarter of the globe that offers greater rewards to the traveler interested in native life, archaeology and natural history than Siam and Indo-China. Mention cannot be made here of the many curious animals that are native to this region, but one may even have opportunity to witness the Archer Fish in action, whose habit of shooting insects for food with a drop of water propelled from its mouth was described in the June NATURAL HISTORY.



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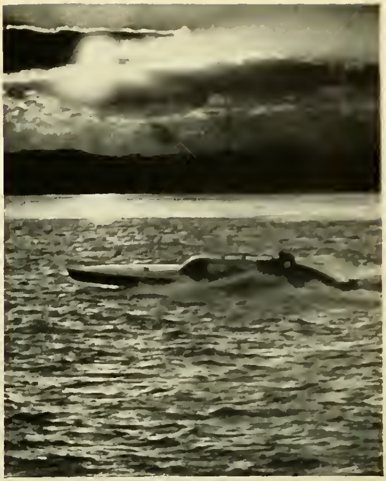

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